

II.—THE STALK-EYED CRUSTACEANS OF THE ATLANTIC COAST OF  
NORTH AMERICA NORTH OF CAPE COD. BY S. I. SMITH.

THIS paper is the result of work done in preparing a more complete account of the crustaceans of the coast of northern New England for the report of the United States Commissioner of Fisheries. The study of the extensive collections of crustaceans, made during the past fourteen years by Professor Verrill and myself, and particularly during the last seven years under the auspices of the Commission for the investigation of the fisheries, promised to add so much to the knowledge of the relations of the fauna of the western side of the North Atlantic, that it has seemed desirable to publish as early as possible the results bearing upon the geographical distribution of the species. This has been long delayed, however, by the great quantity of material which has each year been added to the collections, so that the time at my disposal has been little more than sufficient properly to separate and care for the specimens themselves. In the present paper I have attempted to give these results for the species of stalk-eyed Malacostraca inhabiting the coast between Cape Cod and northern Labrador. Only a very small portion of the species composing the crustacean fauna is thus included, but it is that portion which is best known and consequently most useful in determining the relations of the fauna. Although the paper has special reference to the geographical distribution of the species, considerable matter is introduced in regard to specific variation and specific characters, and, under some of the species, to the synonymy, where it seemed necessary to the proper understanding of the geographical distribution or to show the propriety of the nomenclature adopted, or where the species is not well-known.

The practice among zoologists of neglecting to make clearly apparent what parts of their writings are based on their own observations and what on the works of others, is a frequent source of annoyance and error. This is particularly the case in the statement of the habitats of species, as often given, without the slightest indication whether the occurrence of the species, in each of the regions specified, is known to the author from personal observation or the examination of specimens collected by others, or whether the statement is based

on the writings of other observers, or whether the author has merely conjectured that the species—perhaps never seen by him—inhabits certain regions. Heretofore my own practice has not always been free from fault in this respect, but throughout the following pages I have been careful to indicate distinctly what portions of the statements are based on my own observations and what are merely copied. To do this in the paragraphs devoted to the geographical distribution of the species, I have used the mark of affirmation (!) after each region from or in which I have examined specimens; but to avoid the too frequent repetition of this mark, in cases where the enumeration of several stations or depths immediately follows the name of a special region or locality, it has been placed after the latter only, it being understood that I have examined specimens from all the stations or depths mentioned under that region or locality. The name of the collector, or of the authority for the locality of the specimens examined,—unless I have myself been collector or observer,—is either inserted in parenthesis after the locality or indicated by the date, as explained below. The authorities for all localities from which I have not examined specimens are similarly indicated in parentheses. In the synonymy, all the references given have been made by direct examination of the works quoted, unless specially indicated to the contrary by the use of quotation marks.

To avoid the repetition of the names of collectors, after the numerous localities on our coast, mentioned under the geographical distribution of the species, the year in which the collections were made is, in most cases, alone inserted; and a short statement of the principal sources whence the collections have been received, is inserted here, that portion which is subsequently referred to as authority for collections being arranged chronologically.

1864. Collections made at Eastport, Maine, on the Bay of Fundy, during September and October, by Professor Verrill and the writer.

1868. At the same locality, during August and the early part of September, also at the Island of Grand Menan and in the deep waters off Eastport; by Prof. Verrill, Prof. H. E. Webster, Rev. Geo. A. Jackson, and the writer.

1870. At the same localities and during the same season as in 1868; by Professor Verrill and Mr. Oscar Harger. Also, by myself upon the southern side of Long Island, during August and the early part of September.

1871. Professors Verrill and J. E. Todd, and the writer made collections, for a short time in April, in the neighborhood of Great Egg

Harbor, New Jersey; a special object of the excursion being the determination of the species described from that region by Say.

The systematic exploration of the waters of our coast were this year begun, in connection with the investigations concerning the coast fisheries, under the direction of Professor Baird, United States Commissioner of Fish and Fisheries. Under these auspices, the larger part of the collections referred to in this paper have been made. In 1871, this work was carried on in the region of Vineyard Sound and Buzzard's Bay, from late in June to the middle of September. The dredging operations and the care of the collections of invertebrates were in my charge during the first part of the season, later in care of Prof. J. E. Todd, and finally under the direction of Professor Verrill, more or less assisted by Professors A. Hyatt and A. S. Packard, Jr., and particularly by Prof. W. G. Farlow, who was specially engaged in collecting and studying the algæ.

1872. Under the auspices of the Commissioner of Fisheries, large collections were made, during July and August, at Eastport, Maine, and in the whole neighboring region of the Bay of Fundy. As in the succeeding years, Professor Verrill had charge of the dredging operations and the collections of invertebrates. For a large part of the season Dr. T. M. Prudden cared for the crustaceans and made valuable notes on the stations and color of the species. For a part of the season Prof. H. E. Webster was at the island of Grand Menan where he made valuable additions to the collection of crustaceans, particularly among the species of *Hippolyte*. Several other gentlemen aided in the general work of collecting, and, for a time in August, Mr. Harger and I were present and took part in the work.

During the last of August and September, a series of dredgings were made, on board the Coast Survey steamer *Bache*, in the region of St. George's Banks and the adjacent waters. An account of these dredgings has already appeared in the third volume of these Transactions. This, the earliest exploration with the dredge, of the region referred to, was carried out through the coöperation of Professor Baird and the Superintendent of the Coast Survey. During the first cruise, on which dredgings were made on, and east of, St. George's Banks; at Halifax, Nova Scotia; and on Le Have Bank, the dredging was in charge of Mr. Harger and the writer. On the second cruise, dredgings were made by Prof. A. S. Packard, Jr., and Mr. Caleb Cooke, in the region of St. George's Banks. In the latter region the dredgings extend from north latitude  $41^{\circ} 25'$  to  $42^{\circ} 11'$ , and from west longitude  $68^{\circ} 10'$  to  $65^{\circ} 42'3''$ ; on Le Have Bank, in

a line about southeast from Cape Sable, Nova Scotia, and a little south of latitude  $43^{\circ}$  north. The dredgings made by Professor Packard and Mr. Cooke were at five different stations, all on, or near, the northern slope of St. George's Banks, and in 110, 85, 45, 40, and 150 fathoms.

While waiting at Provincetown, Massachusetts, for the Bache, Mr. Harger and I were able to observe a large number of the shore and shallow-water species, showing the fauna to be intermediate in many respects between the fauna north and that south of Cape Cod.

1873. Collections were made in, and off, Casco Bay, coast of Maine, during July, August, and the early part of September, under the same auspices and direction as in 1872. During the season I had charge of the crustaceans and was greatly aided by Mr. J. H. Emerton, who not only made many most excellent drawings for use in the final reports upon the crustaceans, but also assisted in the work of collecting.

Through the same coöperation as in 1872, the steamer Bache made several trips, during September, to the deeper waters of an extensive region in the Gulf of Maine, between Cape Cod and the coast of the State of Maine. On these trips, Professor Packard and Mr. Cooke took charge of the dredgings, which were made in the following distinct regions: off the coast of Maine, south and east of Penobscot Bay, in 52 to 82 fathoms; a region on and near Jeffrey's Bank, extending from north latitude  $43^{\circ} 15'$  to  $43^{\circ} 36'$ , and from west longitude  $69^{\circ} 6'$  to  $68^{\circ} 25'$ , and at depths from 60 to 107 fathoms; in 52 to 118 fathoms on Cashe's Ledge and to the west of it (the Ledge being in about latitude  $42^{\circ} 50'$ , longitude  $68^{\circ} 50'$ , and the dredgings extending to  $69^{\circ} 35'$ ); on and near Jeffrey's Ledge, off the coast of New Hampshire, in 24 to 33 and 95 to 118 fathoms; in the central part of Massachusetts Bay, in 50 and 65 fathoms; in 24 to 33 fathoms on Stellwagen's Bank, the outer barrier of Massachusetts Bay, situated between Cape Cod and Cape Ann; off Massachusetts Bay, 20 to 25 miles northeast of Cape Cod, in 117 and 142 fathoms; and in shallow water just south of Cape Ann.

In April of this year, Professors Verrill and D. C. Eaton made an excursion to Watch Hill, Rhode Island, and made a small collection of special interest on account of the season of the year.

1874. The dredgings, in connection with the work of the Fish Commission, were carried on in the region about the eastern end of Long Island Sound and extended from the mouth of the Connecticut River, to Gardner's and Peconic Bays, to the waters south of Montauk Point, and to the banks south and east of Block Island.

As in 1873, the steamer *Bache* continued the dredgings in the Gulf of Maine. Professor Packard, assisted by Mr. Cooke and Mr. Robert Rathbun, had charge of the work and made large collections between Cape Ann and the Isles of Shoals, on Jeffrey's Ledge, on Cashe's Ledge, and at numerous localities in the deep waters of the Gulf of Maine.

1875. The work under the direction of the Commissioner of Fisheries was in the same region as in 1871, but the dredgings extended further to the eastward and included the region east of Nantucket.

In addition to this, Professor Verrill and Mr. C. Hart Merriam, during a short excursion to Barnstable, on the north side of Cape Cod, made collections of many of the species inhabiting the shores and shallow waters of the southern part of Cape Cod Bay.

1876. Mr. C. Hart Merriam and Mr. E. B. Wilson made some collections at Eastport, Maine, in April, and very kindly submitted the crustaceans to me. The collection was particularly interesting on account of the season at which it was made, all the other collections which I have examined from the same region having been made late in the summer or early in the autumn.

1877. The extensive collecting prosecuted under the direction of the Commissioner of Fisheries was resumed, the collections of the invertebrates being, as before, in charge of Professor Verrill, who was this year assisted by Mr. E. B. Wilson. Extensive collections were made at Salem, Massachusetts, and in the neighboring waters of Massachusetts Bay and the Gulf of Maine. During a part of the season the work was transferred to Halifax, Nova Scotia, where large collections were made and whence the dredging was extended to the deep waters one hundred and twenty miles south of that city. On the passage from Salem to Halifax, dredgings were made in the deep waters of the Gulf of Maine and off the southern portion of the Nova Scotia coast.

1878. The work in connection with the investigation of the fisheries was continued in the vicinity of Cape Ann, the field investigated being contiguous to, and partially overlapping, that in the vicinity of Salem in 1877. In addition to the material obtained upon the shores and by dredging, valuable collections were procured, at Gloucester, Massachusetts, the head-quarters of the Commission for the season, from vessels engaged in the bank-fisheries. Professor Verrill was specially assisted by Mr. Richard Rathbun and Mr. Sanderson Smith. The collections of this year came to hand too late to be used to any considerable extent in the present paper, and consequently only occasional references are made to them.

I was not able to assist in the work of collecting either in 1877 or 1878, but the crustaceans in the collections of these years have nearly all been placed in my hands in the original packages in which the specimens collected at each special locality were placed, so that I am alone responsible for the determination of the species from each of these special localities.

Several gentlemen, in addition to those above mentioned in connection with the work of the Fish Commission, aided in collecting during different seasons; the gentlemen who were specially engaged in investigating the fishes, also, gave every season, more or less assistance in collecting the invertebrates. Mr. G. Brown Goode, who has for several years had charge of the work upon the fishes, should be particularly mentioned in this connection.

Mention should also be made of the small collections which have, from time to time, been made, in the interest of the United States Fish Commission, by Mr. Vinal N. Edwards in the vicinity of Wood's Holl, Massachusetts (Vineyard Sound and Buzzard's Bay). These collections have been made mostly in the winter and spring and for this reason have proved of special interest, often containing species rarely or never taken in summer, and in several cases materially helping to complete the annual history of a species.

For the use of a few specimens of rare species, not fully represented in the collections above referred to, and also for the freest access to the collections under their charge, I am under obligation to the officers of the Boston Society of Natural History, the Peabody Academy of Science at Salem, and the Portland Society of Natural History. In addition to the use of the collections made under the auspices of the United States Fish Commission, I am indebted to Professor Baird for the opportunities of examining several collections from our southern coast and from Europe, for the loan of books, and for the use of several of the drawings made by Mr. Emerton, which appear in the accompanying plates. To Professor Verrill, I am indebted for the constant use of the valuable collection of crustaceans, of which I formerly had charge, in the Museum of Yale College, as well as for his advice and assistance in many ways. The Museum, in addition to the collections above referred to, contains large collections made in the vicinity of New Haven during many years; an authentic set from the collection which served as a basis for Professor Packard's work upon the invertebrate fauna of Labrador, contained in the first volume of the *Memoirs of the Boston Society of Natural History*; a very valuable series of the crustacea of the coast of Norway, received from

Professor G. O. Sars; a similar series from the British Isles, received from the Reverend A. M. Norman; and a miscellaneous collection of authentically determined species received through Professor A. Milne-Edwards, from the Jardin des Plantes at Paris. These European collections have been of the greatest service for comparison with our closely allied or identical species. The collection from the Reverend Mr. Norman, however, has been received since the following pages were written, so that it is only occasionally referred to.

To the kindness of Mr. J. F. Whiteaves of Montreal, I am indebted for the opportunities of examining very nearly all the crustaceans obtained in his extended explorations of the Gulf of St. Lawrence. Brief accounts of these explorations by Mr. Whiteaves, whose investigations have added very largely to the knowledge of the fauna of the Gulf of St. Lawrence, are contained in his several reports to the Minister of Marine and Fisheries for the Dominion of Canada.

#### *Gelasimus pugnax* Smith.

Salt-marshes at Provincetown! (1872) and Barnstable! (1875), Massachusetts, and south to Florida! (Col. W. E. Foster, Dr. H. S. Williams, et al.) and the island of Hayti! (Dr. D. F. Weinland, J. S. Adam).

#### *Gelasimus pugilator* Latreille ex Bosc.

Muddy and sandy flats, Provincetown!, Massachusetts, 1872, to the west coast of Florida! (Col. E. Jewett). These species of *Gelasimus* and the two following species belong properly to the fauna of southern New England, which, as I have elsewhere remarked, seems to extend across Cape Cod into the shallow waters of Cape Cod Bay.

#### *Callinectes hastatus* Ordway ex Say.

A large specimen of this species has been reported from Salem, Massachusetts, (C. Cooke, American Naturalist, i, p. 52, 1867). This individual was probably only a wanderer from farther south, although the species may occur in Cape Cod Bay, during favorable seasons.

#### *Platyonichus ocellatus* Latreille ex Herbst.

Provincetown! (1872) and Barnstable! (1875), Massachusetts; abundant at the latter place. Fort Macon!, North Carolina (Coles, Packard), to Key West, Florida (Gibbes). Sandy shores and bottoms, low water to 10 fathoms.

***Carcinus mænas*** Leach ex Linné.

Provincetown!, Massachusetts, 1872, to New Jersey!, 1871. The European coast!, from Fimmark (M. Sars) and the Baltic (Möbius) to both sides of the Mediterranean (Grube, Lucas, Heller) and the Black Sea (Rathke). It has also been reported from Brazil by Heller (Reise der Novara, Crust., p. 30, 1865) and from the Hawaiian Islands by Streets (American Naturalist, xi, p. 241; and Bulletin United States National Museum, No. 7, p. 109, 1877). In the Museum of Yale College there is a single specimen, unquestionably of this species, which was sent from Panama Bay, with a large collection of other marine animals, in 1866, by Professor F. H. Bradley. At these last three localities it seems to be very rare, and possibly accidental.

The range of this species upon the eastern coast of North America, as far as I can ascertain from positive information, is very limited. Streets states that "it is by no means an uncommon crab along the whole extent of the eastern coast of the United States," but gives no special localities, and I am inclined to believe that he generalized, very naturally, without carefully examining the facts. From personal observation, I know the species is common and often very abundant in Vineyard Sound, Buzzard's Bay, various parts of Long Island Sound, and in the bays on the south side of Long Island. I also observed it at Provincetown, Massachusetts, in 1872, and at Great Egg Harbor, New Jersey, in 1871. From beyond these limits, either north or south, I have never seen specimens nor any positive record of their occurrence. It is not a regular inhabitant of Casco Bay or the Bay of Fundy. I have examined several large collections from Fort Macon, North Carolina, and others from the coast of South Carolina, both coasts of Florida, Key West, and the east coast of Mexico, without finding a single individual of the species. It is not mentioned in Stimpson's list of Beaufort, North Carolina, species (Amer. Jour. Sci., II, xxix, p. 444, 1860), nor that of Coues for the same locality (Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 120), nor is it mentioned from special localities in the Southern States by Gibbes, nor by any one else as far as I am aware. I know of no other common species of crustacean with a similarly restricted habitat upon our coast.

It is most abundant between tides or near low-water mark and is seldom found below a very few fathoms in depth.

**Geryon quinquedens**, sp. nov.

Plate IX, figures 1, 1a, 1b, 2.

This species is closely allied to *G. tridens* Kröyer (Plate IX, figures 3, 3a) but is at once distinguished from it by the armament of the antero-lateral margins of the carapax.

In the larger specimens, the carapax, including the lateral spines, is about a third broader than long. The dorsal surface is considerably convex longitudinally, but only slightly transversely, entirely naked, finely, but irregularly, granulated, and not deeply areolated. The most prominent elevation is a short, rounded, transverse ridge each side, between the base of the lateral spine and the posterior portion of the gastric region. The front is narrower and more prominent than in *G. tridens*, its breadth between the tips of the inner angles of the orbits only equaling the width of the orbit itself between the tips of its inner and outer angles. The median teeth of the front are near together, triangular, and deflexed below the level of the inner angles of the orbits, in front of which they project for almost or quite their whole length. The outer angles of the orbits are acutely angular, but broader and less spiniform than in *G. tridens*. The next tooth (the second of the five normal teeth of the antero-lateral margin), which is entirely wanting in *G. tridens*, is a well-developed angular projection of the margin, but less prominent than the first tooth and not acutely angular. The third tooth is prominent, acutely triangular, but scarcely spiniform, and much shorter than in *G. tridens*. The fourth tooth, which, like the second, is entirely wanting in *G. tridens*, is represented by a distinct but only slightly angular emargination which is more conspicuous in the smaller than in the larger specimens. The postero-lateral margins are nearly straight as in *G. tridens*. In young specimens the three larger teeth of the antero-lateral margin are more acute and spiniform than in the larger specimens examined.

The eyes, antennule, antennae, and epistome are very nearly as in *G. tridens*, but the inner angle of the inferior margin of the orbit is much less prominent in the new species. In *G. tridens*, this angle projects as a slender tooth to the extremity of the peduncle of the antenna, reaches as far as the outer angle of the orbit and nearly as far as the front itself (Plate IX, figure 3a), while in our species it is much less slender, falls far short of either of the other angles of the orbit and reaches but slightly beyond the third segment of the antenna (figure 1a).

The chelipeds, in the largest male examined (figure 1*b*), as well as in the females and young, are only slightly unequal and rather slender. The fingers on each hand are about as long as the basal portion of the propodus and their thin prehensile edges are armed with sharp serrations which shut slightly by on the two fingers when the dactylus is closed. The dactylus of the larger cheliped, in all the specimens, has, in addition to the serrations, a small obtuse tubercle near the base. In the only specimen of *G. tridens* examined (a male considerably larger than the largest specimens of *G. quinquedens*), the chelipeds are more unequal, the larger being proportionally stouter, and the teeth of the prehensile edges of the fingers are more obtuse and the proximal ones even obtusely tuberculiform; this may be, however, only a character of very old individuals. The sternum, ambulatory legs, and abdomen afford no distinctive characters.

The following are measurements of seven of the nine specimens before me, and also of a specimen of *G. tridens*, from Christiania Fiord, Norway, received from Professor G. O. Sars.

Carapax.	<i>a</i> , ♂	<i>b</i> , ♂	<i>f</i> , ♂	<i>c</i> , ♀	<i>f</i> , ♀	<i>d</i> , ♀	<i>e</i> , ♀	<i>G. tridens</i>
Length including frontal teeth,	33mm	45	28.7	28.5	25.6	21.7	12.2	56
Breadth including lateral spines,	45	58	36.8	38	33.7	29.1	16.7	75
Ratio of length to breadth,	1:1.36	1:1.29	1:1.28	1:1.33	1:1.32	1:1.34	1:1.37	1:1.34
Breadth in front of lateral spines,	39	51.8	32.5	32.3	29.2	24.4	13.8	64
Ratio of length to this breadth,	1:1.18	1:1.15	1:1.13	1:1.13	1:1.14	1:1.13	1:1.13	1:1.14
Length of posterior legs,		95	57	52	50	39	24	115

This very interesting species was first known to me, about ten years ago, from two specimens, in the collection of the Portland Society of Natural History, obtained by Mr. C. B. Fuller from stomachs of fishes taken in deep water off Casco Bay. These specimens were somewhat shrunken from partial digestion, immersion in alcohol and subsequent drying, and the measurements (given above in column *a*) of the smaller one of the two may be slightly incorrect. The other specimens which I have examined were all taken in deep water in the Gulf of Maine, off Massachusetts Bay. The largest two of these (*b* and *c*) were obtained, August 19, 1877, by Professor Verrill and party of the United States Fish Commission on board the "Speedwell," at 160 fathoms, soft muddy bottom, about forty miles east of Cape Ann, latitude 42° 38' north, longitude 69° 38' east. Two others were dredged off Massachusetts Bay by Professor Packard, while on board the "Bache" in September, 1873: a female (*d*), carrying an abundance of eggs, in latitude 42° 18' north, longitude 69° 49' east, 142 fathoms, soft blue mud; and a very small female (*e*), latitude 42° 20' north, longitude 70° east, 117 fathoms, on a bot-

tom of the same character. Four other specimens (*f*), two males and two females, one of which was carrying eggs, were dredged near these localities, August 31, 1878, latitude  $42^{\circ} 33'$ , longitude  $69^{\circ} 35'$ , in 100 to 115 fathoms, mud and stones. Fragments of a large specimen were also found in the stomach of a cod-fish taken in ninety-eight fathoms, soft mud, fourteen miles southeast of Cape Ann, September 2, 1878.

The *G. tridens* was described by Kröyer (Naturhistorisk Tidsskrift, i, p. 10, pl. 1, 1836) from specimens taken on the coast of Denmark. It has since been reported from Christiania Fiord, in ten to twenty fathoms (G. O. Sars, Christiania Videnskabs-Selskabs Forhandling for 1873, p. 393) and a few other Scandinavian localities, and from off Valentia, Ireland, in 159 fathoms (Thomson, "Depths of the Sea," p. 87, fig. 9, 1873). Like its American representative, it seems to be a deep-water species rarely taken in the dredge.

#### *Panopeus depressus* Smith.

Provincetown! (1872), Massachusetts, to the Gulf of Mexico! (Col. E. Jewett, et al.). This and the next species are apparently regular inhabitants of Cape Cod Bay. They are both, but more particularly this species, very abundant upon oyster-beds everywhere south of Cape Cod and are often carried alive long distances among oysters, so that it is difficult to determine their exact northern range.

#### *Panopeus Sayi* Smith.

Provincetown! (1872), Massachusetts, to the Gulf of Mexico! (Col. E. Jewett). Apparently less abundant, at least on the New England coast, than the last.

#### *Panopeus Harrisii* Stimpson ex Gould.

Massachusetts Bay! (Coll. Boston Soc. Nat. Hist.) and Long Island Sound! to St. John's River, Florida! (G. Brown Goode). This species, originally described by Gould, from Charles River, Massachusetts, is apparently a thoroughly brackish-water form. The specimens from the St. John's River, as I am informed by Mr. Goode, were taken at Arlington Bluffs, twenty-two miles from the mouth. It was associated at this place with *Sesarma cineria*, *Palaemonetes vulgaris*, and a *Bopyrus* which infested the branchial cavity of nearly every specimen of the latter species. Mr. Goode writes that these species were taken in water perfectly fresh to the taste, though brackish water is sometimes driven by the wind up the river to where they occurred.

**Cancer irroratus** Say.

*Cancer irroratus* (♂ only, ♀ being of the next species) Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 59, pl. 4, fig. 2, 1817.—Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 50 (4), 1859.—A. Milne-Edwards, Nouvelles Archives du Muséum d'Hist. nat. Paris, i, p. 191, 1865.—Verrill, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner of Fish and Fisheries, part i, p. 312 (18), 1874.—Smith, in Verrill, op. cit., pp. 530 (236), 546 (252), 1874.

*Platycarcinus irroratus* Milne-Edwards, Hist. nat. des Crust., i, p. 414, 1834.—DeKay, Nat. Hist. of New York. Crust., p. 6 (in part), pl. 2, fig. 2, 1844.

*Cancer Sayi* Gould, Report on Invertebrata of Massachusetts, 1st edit., p. 323, 1841.

*Platycarcinus Sayi* DeKay, op. cit., p. 7, 1844.—Gibbes, Proceedings Amer. Assoc. Adv. Sci., 3d meeting, p. 176 (12), 1850.

*Cancer borealis* Packard, Memoirs Boston Soc. Nat. Hist., i, p. 303, 1867.

South Carolina (Gibbes), apparently rare. Fort Macon, North Carolina! (Cones, Yarrow). Great Egg Harbor!, New Jersey, 1871; apparently not very common in the muddy bays, but thrown up in large numbers upon the sandy outer beaches. Southern shore of Long Island!, 1870; on sandy beaches. Long Island Sound!; abundant on sandy and rocky shores. Equally abundant, in similar situations, along all the rest of the south coast of New England, and in Cape Cod! (1872, 1875), Massachusetts! (1877, 1878), and Casco! (1873) Bays. Apparently much less abundant in the Bay of Fundy! (1864, 1868, 1870, 1872), and at Halifax!, Nova Scotia (1872, 1877). Gulf of St. Lawrence!, 1873; "the common crab of the Gulf" (Whiteaves). "Not uncommon at Caribou Island, Straits of Belle Isle," south coast of Labrador! (A. S. Packard, Jr.).

The exact bathymetrical range of the adult is not easily determined, since full-grown specimens are seldom taken in the dredge. Specimens of considerable size were frequently taken in the trawl in Vineyard Sound, in from 6 to 12 fathoms, but I have never seen adult specimens from below the latter depth, although young individuals are often taken at much greater depths. Small specimens, from 10 to 25<sup>mm</sup> in breadth of carapax, were common in shallow-water dredgings in Vineyard Sound! and Buzzard's Bay!, 1871, 1875, and were taken off Newport!, Rhode Island, in 29 fathoms, mud, 1871; in the region of St. George's Banks!, 30 to 50 fathoms, sand, sand and shells, and coarse sand, 1872; on Stellwagen's Bank!, 34 to 44 fathoms, sand, 1873,—one specimen about 40<sup>mm</sup> in breadth of carapax; off Cape Ann!, Massachusetts, 26 fathoms, rocks, 1878; not rare on sandy and hard bottoms in Casco Bay!, in 5 to 10 fathoms, and once taken, between Eagle and Bates Islands, in 24 fathoms, hard bottom, 1873; several localities in and near Halifax Harbor!,

Nova Scotia, 16 to 21 fathoms, on bottoms of fine sand, and of fine sand and red algæ, 1877.

Found in abundance in the stomachs of the cod (!) taken in Casco Bay and the Bay of Fundy.

When found living between tides it is usually concealed among rocks or buried beneath the sand. It is usually much more abundant at or just below low-water mark than between tides, however.

The largest specimens I have examined are from Casco Bay. One of these, a male, has the carapax 83<sup>mm</sup> long and 129·2<sup>mm</sup> broad.

### *Cancer borealis* Stimpson.

*Cancer irroratus* (♀ only, ♂ belonging to the last species) Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 57, 1817.—Gould, Report on the Invertebrata of Massachusetts, 1st edit., p. 322, 1841.—Stimpson, Marine Invertebrata of Grand Manan, p. 59, 1853 (*teste* Stimpson).

*Platycarcinus irroratus* DeKay (in part), Nat. Hist. of New York, Crust., p. 6 (but not the figure), 1844.—Gibbes, Proceedings Amer. Assoc. Adv. Sci., 3d meeting, p. 177 (13), 1850.

*Cancer borealis* Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 54 (4), 1859.—Verrill, Invertebrate Animals of Vineyard Sound, pp. 486 (192), 493 (199) 1874.—Smith, in Verrill, op. cit., pp. 546 (252), 745 (451), 1874.—Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, p. 317 (2), 1878.

### Plate VIII.

Near Noank!, Connecticut (eastern end of Long Island Sound), 1874. Off Watch Hill!, Rhode Island, April, 1873; a small specimen dredged in four to five fathoms, among rocks and algæ. Nomansland!, 1871. Vineyard Sound!, 1871, 1875. Salem!, Massachusetts (J. H. Emerton). Casco Bay!, 1873. Bay of Fundy and Nova Scotia (Stimpson).

Leidy (Journal Acad. Nat. Sci. Philadelphia, iii, p. 149 (17), 1855) mentions "*Platycarcinus irroratus* M. Edw." and "*P. Sayi* DeKay" from Point Judith, Rhode Island, and Great Egg Harbor, New Jersey, intending, doubtless, to indicate both our species of *Cancer*, although the names with the authorities as given are in reality synonymous and apply to *C. irroratus* only.

Kingsley (*loc. cit.*) reports a young specimen of this species from Fort Macon, North Carolina. He also says: "I am informed by Mr. Faxon that there are specimens in the Museum of Comparative Zoology, at Cambridge, from the Bermudas," and that "it ranges from Nova Scotia to the West Indies," but fails to give any explanation of this last extension of its range southward.

In habits this species differs very greatly from *irroratus*. The best opportunities which I have had for observing it were at Peak's Island, in Casco Bay, August and September, 1873. Empty carapaces, chelipeds, etc., of *borealis* were at first found in abundance scattered along the outer shores, far above the action of the waves, where they had evidently been carried by gulls and crows, and were also found in considerable numbers half a mile from the shore in a forest of coniferous trees thickly inhabited by crows. For several weeks no living specimens of *borealis* were discovered, although the *irroratus* was found living in abundance all about the island, without, however, its remains scarcely ever being found scattered about with those of *borealis*. The *borealis* was finally discovered in abundance, at low water, on the exposed and very rocky shores of the northern end of the island. At this locality, between eighty and ninety specimens, all females and many of them carrying eggs, were obtained in a single morning. They were all found in situations exposed to the action of the waves and were either resting entirely exposed upon the bare rocks and ledges, or clinging to the sea-weeds in the edge of the waves or in the tide-pools. They were never found concealed beneath the rocks, where, however, *irroratus* abounded. It is a much heavier and more massive species than the *irroratus* and is consequently much better adapted than that species to the situations in which it is found. So many individuals falling a prey to birds is evidently a result of the habit of remaining exposed between tides, although the heavy shell must afford much greater protection than the comparatively fragile covering of *irroratus* would afford to that species if similarly exposed. The *borealis* was also found at a somewhat similar locality, but more exposed to the sea, on Ram Island Ledge, a low reef open to the full force of the ocean. One specimen of moderate size was dredged in the ship channel between Peak's Island and Cape Elizabeth, in ten fathoms, rocky and shelly bottom, and specimens were several times captured in "lobster-traps" set, at a depth of eight or ten fathoms, among rocks. Specimens were also several times found in stomachs of the cod taken on the Cod Ledges.

In the vicinity of Vineyard Sound, this species was not infrequently found thrown upon sandy beaches, but never upon beaches very far removed from rocky reefs. The following are the localities where it was seen in greatest numbers: along the sandy beach of Martha's Vineyard from Menemsha Bight to Gay Head; the rocky island of Cuttyhunk; and the rocky outer shores of Nomansland, where dead specimens were found in considerable abundance.

In the vicinity of Noank, Connecticut, it was occasionally found dead upon the shores and was several times obtained from "lobster-traps."

The largest specimens I have seen are two males, of almost exactly the same size, one from Casco Bay, the other from near Noank, Connecticut. The carapax of the specimen from Casco Bay is 91·6<sup>mm</sup> long and 144·5<sup>mm</sup> broad.

### *Chionœcetes opilio* Krøyer.

*Cancer phalangium* O. Fabricius, Fauna Grœnlandica, p. 234, 1780 (not of J. C. Fabricius, 1775).

"*Cancer opilio* O. Fabricius, Det Kongelige Danske Vidensk. Selskabs Skr., nye Samling., iii, p. 180" (*teste* Krøyer).

*Chionœcetes opilio* Krøyer, Grønlands Amphipoder, Det Kongel. Danske Vidensk. Selskabs naturvidensk. og mathem. Afhandlinger, vii, p. 313 (85), 1838; *Conspectus Crustaceorum Grœnlandiæ*, Naturhistorisk Tidsskrift, ii, p. 249, 1838; in Gaimard, *Voyages en Scandinavie, en Laponie, au Spitzberg et aux Féroë*, *Crust.*, pl. 1, 1849.—Packard, *Memoirs Boston Soc. Nat. Hist.*, i, p. 302, 1867.—Whiteaves, Report on a second deep-sea dredging expedition to the Gulf of St. Lawrence [in 1872], p. 15, 1873.

*Peloptastus Pallasii* Gerstæcker, *Carcinologische Beiträge*, *Archiv für Naturgeschichte*, xxii, 1856, p. 105, pl. 1, fig. 1.

*Chionœcetes Behringianus* Stimpson, *Proceedings Boston Soc. Nat. Hist.*, vi, p. 84, 1857; *Journal Boston Soc. Nat. Hist.*, vi, p. 448 (8), 1857; *Proceedings Acad. Nat. Sci. Philadelphia*, 1857, p. 217 (23), 1858.

*Chionocoetes phalangium* Lütken, list of the Crustacea of Greenland, in *Manual of Instructions for the [British] Arctic Expedition*, 1875, p. 146.

From fish-stomachs, off Casco Bay! (C. B. Fuller, *Portland Soc. Nat. Hist.*), *h*. Two localities off the coast of Nova Scotia!, 1877: two specimens (*e, f*) off Cape Sable, 88 fathoms, very fine sand; and four small specimens about twenty-six miles south of Chebucto Head, 101 fathoms, fine sand. A large male specimen (*d*) in the collection of the Boston Society of Natural History is without indication of locality, but probably came from one of the fishing banks. Gulf of St. Lawrence (Whiteaves). Straits of Belle Isle and Chateau Bay!, coast of Labrador (A. S. Packard, Jr.), *a, b*. Greenland (O. Fabricius, Krøyer, Norman). Siberia (Gerstæcker). Arctic Ocean! (Capt. Rodgers, *North Pacific Expl. Expl.*), *i*. Bering Straits! (*North Pacific Expl. Expl.*), *c, g*.

A careful comparison of three of the original specimens of *C. Behringianus* with specimens from our North Atlantic coast, and with Krøyer's figure and description, convinces me that Stimpson's species is perfectly identical with the *C. opilio* of Greenland. The differ-

ences in the proportional lengths of the first and second pairs of legs, referred to by Stimpson, are variations due wholly to age and sex. The proportions given by Kröyer apply well to large males, like the specimen represented in his figure above referred to, while those given by Stimpson apply to specimens of smaller size. The following measurements exhibit these variations and show that they are even much greater in very young specimens than indicated by Stimpson. The proportions of the carapax in the specimen from Casco Bay (*h*) may have changed slightly by contraction in drying after partial digestion in a fish-stomach.

	<i>a.</i>	<i>b, ♂.</i>	<i>c, ♂.</i>	<i>d, ♂.</i>	
Length of carapax,	11·7mm.	17·0	27·3	115	
Breadth of carapax,	9·5	15·0	25·2	120	
Ratio of length to breadth,	1:0·81	1:0·88	1:0·92	1:1·04	
Between external angles of orbits,	7·3	9·6	14·0	49	
Length of cheliped,	11·5	28·5	32	220	
Length of anterior ambulatory leg,	19·5	31·0	55	300	
	<i>e, ♀.</i>	<i>f, ♀.</i>	<i>g, ♀.</i>	<i>h, ♀.</i>	<i>i, ♀.</i>
Length of carapax,	22·2	33·0	35·0	59	64·0
Breadth of carapax,	21·1	33·0	34·3	65	68·5
Ratio of length to breadth,	1:0·95	1:1	1:0·98	1:1·10	1:1·07
Between external angles of orbits,	12·3	17·2	18	27	
Length of cheliped,	23·0	37·7	36	67	
Length of anterior ambulatory leg,	44·3	72	61	120	125

Upon the New England coast this species is very rare and apparently confined to deep water and to the off-shore banks. It is one of the largest arctic crabs and occasionally attains gigantic proportions. The extent of the ambulatory legs, in the largest individual referred to above, was about 800 millimeters (over two and a half feet), while the specimen figured by Kröyer was even somewhat larger.

I have not been able to consult Otho Fabricius' original description of *Cancer opilio*, referred to by Kröyer, nor even to ascertain with certainty the exact date of its publication, which was very likely subsequent to that of *Cancer opilio* of J. C. Fabricius (*Entomologia systematica*, ii, p. 458, 1793), which is *Inachus opilio* of the same author (*Supplementum entom. system.*, p. 356, 1798) and the *Pisa armata* of Milne-Edwards. Even if priority of publication belongs to the species of J. C. Fabricius, I should not regard such a preëccupation in the ancient genus *Cancer* as sufficient reason for rejecting a name so well-established as *opilio* for the species under discussion. I see far less reason for restoring the old name *phalangium* which had not been in use for this species for more than three quarters of a

century, which was certainly preoccupied by J. C. Fabricius' *Cancer phalangium* (*Stenorhynchus phalangium* Milne-Edwards), and which was apparently rejected by Otho Fabricius himself.

**Hyas araneus** Leach ex Linné.

Massachusetts Bay, about ten miles southeast from Salem!, 35 fathoms, mud and clay nodules, 1877; Stellwagen's Bank!, 22 to 34 fathoms, sand and rocks, common, 1873. Casco Bay!, 1873, at the following localities: Haddock Ground off Whaleboat Island, 14 fathoms, gravel and broken shells; Broad Sound, 16 to 22 fathoms, stones and shells; northwest of Eagle Island, 13 fathoms, spongy bottom. Bay of Fundy!, 1868, 1872. Le Have Bank!, latitude 42° 44' north, longitude 64° 36' west, 60 fathoms, sand and gravel, 1872. Off Chebucto Head!, Nova Scotia, 20 fathoms, mud and fine sand, 1872. In and near Halifax Harbor!, N. S., 1877: 16 to 21 fathoms, very fine sand and red algæ; 18 fathoms, mud and fine sand, Sept. 15, very large specimens, some carrying eggs; 16 to 25 fathoms, rocks and nullipora, and stones, gravel, etc.; also in Bedford Basin, 35 fathoms, soft mud, a small specimen only. Newfoundland Banks!, from stomachs of cod-fish (collection Boston Soc. Nat. Hist.). Gulf of St. Lawrence!, "rare" (Whiteaves). Labrador! (A. S. Packard, Jr.).

Greenland (O. Fabricius, Krøyer et al.); Disco Island, 5 to 20 fathoms (Valorous Cruise, Norman). Sea of Ochotsk (Brandt, Middendorff's Sibirische Reise, Krebse, p. 79, 1851). Iceland (G. O. Sars). Spitzbergen (Goës, Æfversight af Kongl. Vetenskaps-Akad. Förhandlingar, Stockhohn, 1863, p. 161 (1)). Coast of Norway! (G. O. Sars), British Islands! (Norman), and on the continent of Europe, as far south as the coast of Belgium (Van Beneden), and according to Milne-Edwards (Hist. nat. des Crust., i, p. 312, 1834) to that of France.

Upon our coast this species is much less abundant than the next. I have never seen specimens from south of Cape Cod.

**Hyas coarctatus** Leach.

Coast of New Jersey (Leidy) and of Long Island (Say). Block Island Sound!, 8 to 15 fathoms, stones, gravel and sand; and Cox's Ledge!, east-southeast of Block Island, 21 fathoms, rocky bottom, 1874. Stellwagen's Bank!, 22 to 44 fathoms, rocky and sandy,—abundant; Jeffrey's Ledge!, 24 fathoms, gravel and stones,—abundant; and Massachusetts Bay!, 29 and 33 fathoms, gravel and stones, 1873. Massachusetts Bay, off Salem!, 1877: 22 fathoms, gravelly; 48 fathoms, soft mud, August 13,—some females carrying eggs. Gulf of

Maine!, off Cape Ann; seven miles southeast by east one-half east of Cape Ann, 75 fathoms, soft mud, 1878; thirteen miles southeast from the same point, 50 fathoms, mud and stones, 1878; and fourteen miles southeast from the same point, 90 fathoms, soft mud, 1877. Platt's Bank! (latitude  $43^{\circ} 11'$  north, longitude  $69^{\circ} 35'$  west), 32 fathoms, sand; and near Jeffrey's Ledge!, 51 fathoms, mud and gravel, and 125 fathoms, mud, 1874. Casco Bay!, 1873: many localities in and near Portland Harbor, 9 to 24 fathoms, muddy, gravelly, and rocky bottom; East and West Cod Ledges, 10 to 15 fathoms, very rough and rocky,—taken with both the dredge and tangles, and also, in abundance, from stomachs of the "rock-cod;" 33 fathoms, hard, and 35 fathoms, muddy bottom, off Seguin Island; 64 and 68 fathoms, mud, sixteen to twenty miles southeast of Cape Elizabeth,—large specimens. Off the coast of Maine, near Monhegan Island!, 42 to 65 fathoms, muddy and gravelly bottom, 1874. Cashe's Ledge!, 27 to 40 fathoms, rocks and gravel, 1873, and 52 to 90 fathoms, rocky, 1874,—abundant. St. George's Banks!, 1872; 45 fathoms, coarse sand; 50 fathoms, sand and shells; 60 fathoms, gravel, stones and sponges. North of George's Banks!, latitude  $42^{\circ} 11'$  north, longitude  $67^{\circ} 11'$  west, 150 fathoms, soft sandy mud, 1872. Bay of Fundy!, 1864, 1868, 1870, 1872, rarely taken among rocks at low-water mark!, and not uncommon in 10 to 77 fathoms.

West of Brown's Bank!, about latitude  $42^{\circ} 44'$  north, longitude  $66^{\circ} 27'$  west, 75 fathoms, sand and mud, 1877. Le Have Bank!, 45 fathoms, gravel and stones, and 60 fathoms, sand, gravel and stones, 1872. Off Cape Negro and off Shelburne, Nova Scotia!, 47 fathoms, stony, and 59 fathoms, pebbles, sand and rocks, 1877. In and near Halifax Harbor, Nova Scotia!, 1877, 18 to 57 fathoms, common on bottoms of rocks, rocks and nullipora, gravel and sand, fine sand and mud, and sand and red algae. Newfoundland Banks!, from stomachs of cod-fish (collection Boston Soc. Nat. Hist.). Gulf of St. Lawrence! (Whiteaves). Labrador! (A. S. Packard, Jr.).

Greenland (Reinhardt et al.); Disco Island (Norman). Norway! (G. O. Sars), British Islands! (Norman), and the continent as far south as the British Channel (Milne-Edwards). Stimpson has reported this species as collected by the North Pacific Exploring Expedition, in Bering Straits and Bering Sea (Journal Boston Soc. Nat. Hist., vi, 450 (10)), and Brandt (op. cit., p. 79) records a variety, which he names "*alutacea*" (*us*), from the Sea of Ochotsk. Stimpson, however, subsequently (Proceedings Acad. Nat. Sci. Philadelphia, 1857, p. 227 (24)) in his official report makes no mention of specimens of

*H. coarctatus* but describes a new species, *latifrons*, as common in Bering Sea, apparently using the same specimens which were a few months before referred to *H. coarctatus*. *H. latifrons*, though closely allied to *coarctatus*, is certainly a good species, or a very remarkable variety, and quite distinct from Brandt's variety *alutaceus*. The occurrence of the true *coarctatus* in the arctic region west of America is therefore left doubtful.

This species apparently furnishes an important part of the food of the cod.

#### *Libinia emarginata* Leach.

*Libinia emarginata* Leach, Zoological Miscellany, ii, p. 130, pl. 108, 1815.

*Libinia canaliculata* Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 77, pl. 4, fig. 1, 1817.

Not uncommon in the shallow parts of Casco Bay! where protected from the cold outside waters, 1873. More common in Massachusetts! and Cape Cod! (1875) Bays. Abundant in Vineyard Sound! and Buzzard's Bay!, 1871, 1875, and south to Key West!, Florida, (Gibbes), Nassau!, New Providence (Dr. Edward Palmer), and the west coast of Florida! (Col. E. Jewett).

It is a strictly shallow-water species, probably never occurring below ten fathoms, and appears to delight in muddy bays and inlets where the water is slightly brackish, though it often lives in pure sea-water and in exposed situations.

Leach's name *emarginata* takes precedence of Say's *canaliculata*. Leach states that "the locality of this species, which is the only one of the genus which has yet been observed, is unknown." A careful examination of his figure (which represents a female with the carapax about 65 millimeters long) convinces me of the certainty of the identity of his species with that of Say. White (List of Crust. in British Museum, p. 4) doubtfully retains the two species, although he places two males from Boston, U. S., under *emarginata* with Leach's type. The variation due to sex and age are very marked, and both Milne-Edwards and White probably failed to unite the species from want of a good series of specimens. Although Say mentions Leach's figure he evidently compared it with males of his species, from which alone his description was apparently taken.

#### *Lithodes maia* Leach ex Linné.

Off Cape Ann!, Massachusetts, 1875 (received from fishermen). Casco Bay! (Museum Yale College, received from A. S. Packard, Jr.) Cashe's Ledge!, Gulf of Maine, 52 to 90 fathoms, rocky, 1873. In

1878, fine specimens were obtained from off Sable Island!, Nova Scotia, 250 fathoms, rocks (Philip Merchant and Thomas Ginnevan, schooner "Marion"); from Marble Head Bank (schooner "Charger"); and one caught, in 1872, in Harbor Cove, Gloucester (Edw. W. Hodgkins). Specimens are occasionally brought from different fishing banks off the coast, where they are taken on trawl or cod lines, especially upon rocky bottoms. It has been reported from Greenland, but it is not inserted in Reinhardt's list (Rink's *Naturhistoriske Bedrag til en Beskrivelse af Grönland*, 1857, p. 28) and Lütken in a foot-note to his list (Manual of Instructions for the [British] Arctic Expedition, 1875, p. 146) says its occurrence in Greenland needs confirmation.

In Europe it is found upon the whole Atlantic coast of Scandinavia! (G. O. Sars), about the northern portions of the British Islands, and, according to Van Beneden, rarely upon the coast of Belgium.

*Eupagurus bernhardus* Brandt ex Linné.

Not rare in the eastern part of Long Island Sound!, Block Island Sound!, and off Block Island!, in 10 to 50 fathoms, sandy and hard bottoms, 1874; all the specimens small, however. Off Newport!, Rhode Island, 29 fathoms, 1872. Not uncommon in the deeper parts of the outer portion of Vineyard Sound!, 1871 and 1875; large specimens were taken in 8 to 12 fathoms, sandy bottom, near Menemsha Bight, and also at about the same depth, rocky bottom, off Gay Head. South of Cape Cod, it appears not to be abundant and I have never seen it at low-water.

Stellwagen's Bank!, 34 fathoms, sand, 1873. Gloucester!, Massachusetts, abundant at and just below low-water, 1878. Off Cape Ann!, 33 fathoms, gravel and stones, 1873. Very common in Casco Bay!, 1873, in 3 to 30 fathoms, sandy, gravelly, rocky, shelly and spongy bottoms, and occasionally on soft muddy bottoms in shallow water; dredged also in 48 to 64 fathoms, mud, sixteen to twenty miles off Cape Elizabeth, and found at low-water mark!, among rocks, on Ram Island Ledge. In the Bay of Fundy!, 1864, 1868, 1870 and 1872, it was occasionally found at low-water, and was common at the same depths and on similar bottoms as in Casco Bay; also dredged off White Head!, Grand Menan, in 40 to 50 fathoms, 1872. In the region of St. George's Banks!, 1872, it was dredged in abundance in 25 to 45 fathoms, sand; and in less abundance in 50 fathoms, sand and shells, and 150 fathoms, sandy mud. In and near Halifax Harbor, Nova Scotia!, 18 to 25 fathoms, sand, gravel, stones, and sand and

red algæ, 1877. I have never seen specimens from the Gulf of St. Lawrence nor Labrador and can find no record of its occurrence on our eastern coast north of Halifax. I have little doubt however that it occurs in the southern part of the Gulf of St. Lawrence.

On the European coast it is found from Finmark (M. Sars) and the rest of the Norwegian coast! (G. O. Sars) to the Baltic, the North Sea! (Möbius, Metzger), the British Islands! (Norman), and south to the coast of France (Milne-Edwards).

It is also reported from the region of Bering Sea by Owen and Brandt, and by Stimpson from Puget Sound.

**Eupagurus longicarpus** Stimpson ex Say.

Egmont Key!, west coast of Florida, common (Col. E. Jewett). Charleston, South Carolina (Gibbes). Fort Macon!, North Carolina, abundant (Coues, Packard). Also abundant on the coast of New Jersey!, 1871; southern shore of Long Island!, 1870; throughout Long Island Sound!; Block Island Sound!, 1874; Gardiner's!, Great Peconic! and Little Peconic! Bays, Long Island, 1874; Buzzard's Bay!, and Vineyard Sound!, 1871, 1875. Cape Cod Bay!, 1875, and Provincetown!, Massachusetts, 1872. Salem, Massachusetts (Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 326). Common at low-water, in a shallow and sheltered cove at the upper end of Quahog Bay!, an arm of Casco Bay, 1873.

It is most abundant at low-water or between tides on muddy and sandy shores and is seldom if ever found below 10 fathoms.

**Eupagurus pubescens** Brandt ex Kröyer.

Off the coast of New Jersey!, latitude  $40^{\circ}$  north, longitude  $73^{\circ}$  west, 32 fathoms, inhabiting shells overgrown with *Epizoanthus Americanus* Verrill (Capt. Gedney). Off Block Island!, 14 fathoms, sand and gravel, 1874. Stellwagen's Bank!, 22 to 44 fathoms, sand, 1873,—abundant. Massachusetts Bay!, off Salem, 1877: 22 and 45 fathoms, gravel; 33, 35 and 36 fathoms, sand and mud; and abundant in 48 to 50 fathoms, mud. Gulf of Maine!, off Cape Ann: seven miles southeast by east one-half east from Cape Ann, 75 fathoms, soft mud, 1878,—abundant; thirteen miles southeast from the same point, 50 fathoms, mud and stones, 1878; and fourteen miles southeast from the same point, 90 fathoms, soft blue mud, 1877,—abundant and very large. Off Massachusetts Bay!, latitude  $42^{\circ} 20'$  north, longitude  $70^{\circ}$  west, 117 fathoms, soft blue mud, 1873. Common in Casco Bay!, 1873, on muddy, sandy, shelly and spongy bottoms in 10 to 48

fathoms; also found at low-water mark!, among rocks, at Ram Island Ledge, and dredged in 48 to 64 fathoms, mud, 16 to 20 miles off Cape Elizabeth. In the Bay of Fundy!, 1864, 1868, 1870 and 1872, it was found in abundance at about the same depths as in Casco Bay, was rarely found at low-water mark, and, in 1872, was dredged in 77 fathoms, mud and stones, off Head Harbor, near Eastport, and also in 97 to 105 fathoms, gravel and sand, off White Head, Grand Menan. In 1873, it was dredged, eight miles south off Monhegan Island!, off the coast of Maine, in 64 fathoms, mud and sand; and in 1874, on Cashe's Ledge!, in 27 fathoms, rocks and gravel. In the region of St. George's Banks!, 1872: 30 and 40 fathoms, sand; 50 and 60 fathoms, sand and shells; 65 fathoms, dead shells; and 150 fathoms, sandy mud. About thirty miles southeast one-half east from Cape Sable!, Nova Scotia, 88 fathoms, very fine sand, 1877. In Bedford Basin!, Halifax, 35 fathoms, soft mud, 1877. In and near Halifax Harbor!, 1877, 15 to 42 fathoms, sand, sand and red algæ, rocks, mud and stones. Gulf of St. Lawrence! (Whiteaves). Labrador! (Packard). Greenland (Kröyer, Norman). Bering Sea (Brandt, Stimpson). In the European seas, upon the coasts of Scandinavia and the British Islands.

On account of the apparent confusion of this species with the next I am not able to give the range of either of them upon the European coast with any certainty.

#### **Eupagurus Kröyeri** Stimpson.

This species and the last, although very closely allied and having apparently very similar geographical distribution, appear to be entitled to rank as distinct species; at least I have not been able to discover, in examining several hundreds of specimens, any which are intermediate between the two forms indicated by Stimpson. The *Kröyeri* attains nearly or quite as great size as the *pubescens*, but Stimpson had only small specimens of *Kröyeri* and the differences which he mentions in the relative lengths of the chelipeds and ambulatory legs do not hold good for full-grown specimens. The other differences which he points out, however, are quite sufficient for separating the species. The difference in the amount of pubescence is usually fully sufficient to distinguish them at a glance, but the form and ornamentation of the chelipeds afford the best distinctions. The tubercles and spines,—except the single series along the edge of the dorsal carina of the propodus of the left, or smaller, cheliped,—are

much smaller and more crowded on both chelipeds in *Kröyeri* than in *pubescens*. In *Kröyeri* the outer or left hand edge of the propodus of the smaller cheliped, as seen from above, is distinctly incurved near the base of the digital portion, while in *pubescens* the corresponding edge is full and regularly, though not strongly, arcuate, so that the digital portion of the propodus is much wider toward the base than in *Kröyeri*. In *Kröyeri* the dorsal carina of the propodus of the smaller cheliped is much nearer the right side toward the base than in *pubescens*, is very high and sharply prominent, and surmounted by a single series of dentiform teeth; the narrow space beneath the carina to the right is nearly or quite destitute of spines or tubercles; and the outer surface, or that to the left of the carina, is flat or slightly concave, and covered with very small tubercles. In *pubescens* the carina is low, obtuse and armed with a crest of spines which becomes a double series proximally; and the outer surface is slightly convex and is armed with scattered spiniform tubercles.

Kröyer's figure in Gaimard's *Voyages en Scandinavie*, Crustacés, plate ii, figure 1, evidently represents the *Kröyeri*, although the tubercles upon the chelipeds are represented in the figures as a little too large and more scattered than in any specimens I have seen, but this is probably due to a slight and very natural inaccuracy on the part of the artist or engraver; the original description of *Pagurus pubescens* (*Naturhistorisk Tidsskrift*, ii, p. 251, 1839), however, applies best to the other species, which Kröyer evidently had before him when writing the first phrase of the diagnosis, "cephalothoracis superficie dorsali pedibusque pilis flavis dense obsitis," which would not apply to any specimens of *Kröyeri* or to his figure published ten years after. Kröyer mentions having numerous specimens from different places on the Greenland coast and from Iceland, and it is probable, as Stimpson suggests, that he failed to distinguish the two species, as nearly all carcinologists have done since.

While having a geographical range similar to the *pubescens*, the *Kröyeri* is apparently a more strictly arctic species, and, upon the New England coast, is most common in deep water and upon the off-shore banks.

Stellwagen's Bank!, 29 to 44 fathoms, rocky and sandy, 1873, common. Massachusetts Bay!, off Salem, 43 and 50 fathoms, mud, 1877. Casco Bay!, 8 to 30 fathoms, rocky, spongy and sandy bottoms, and occasionally on muddy bottoms also, 1873. Bay of Fundy!, 1864, 1868, 1870, 1872, in similar situations as in Casco Bay, and more common and of larger size; in 1872, it was also dredged off Head

Harbor in 77 fathoms, mud and stones; and off White Head, Grand Menan, in 40 to 50 fathoms, and 97 to 105 fathoms. In the region of St. George's Banks!, 1872, it was common in 50, 60 and 65 fathoms, sand and shells; 45 fathoms, coarse sand; 150 fathoms, sand and mud; and six rather small specimens were brought up from 430 fathoms, sand, gravel and stones. Near Cashe's Ledge!, Gulf of Maine, 52 to 90 fathoms, rocky; 65 fathoms, mud and sand, and 110 fathoms, mud, 1873-4. Fifteen miles southeast of Monhegan Island!, off the coast of Maine, 82 fathoms, brown mud, 1873. Off Shelburne!, Nova Scotia, 47 fathoms, stony, 1877. Le Have Bank!, 45 fathoms, gravel and stones, and 60 fathoms, stones and sponges, abundant, 1872. Halifax Harbor!, Nova Scotia, 16 fathoms, fine sand and red algæ, 1877. Off Halifax!, 57 fathoms, mud and pebbles, 1877. One hundred and twenty miles south of Halifax!, 190 fathoms, 1877. Gulf of St. Lawrence!, "widely distributed through the Gulf" (Whiteaves). Labrador (A. S. Packard, Jr.). Greenland (Krøyer). Puget Sound (Stimpson). Lofoten Islands!, coast of Norway (G. O. Sars), and probably all the coast of northern Europe. Those from the coast of Norway, labeled *pubescens* by Professor G. O. Sars, are very characteristic specimens of *Krøyeri*. Norman's remark under *Pagurus pubescens* (Last report on dredging among the Shetland Isles, Report British Assoc. Advanc. Sci. for 1867, p. 264) that "a variety occurs in which the hands are entirely free from the hairs which ordinarily clothe them" probably refers to this species.

#### Parapagurus, gen. nov.

The genus here proposed is allied to *Eupagurus* and *Paguristes*, but the branchiæ (of which there are eleven pairs, two each at the bases of the external maxillipeds and the three first pairs of cephalothoracic legs, and three at the bases of the fourth pair of cephalothoracic legs,—as in *Eupagurus bernhardus*) are composed of numerous cylindrical papillæ, as in the majority of *Maerura*, instead of lamellæ, as in most *Paguroids*. It also differs from *Eupagurus* in having well-developed and symmetrically paired male appendages upon the first and second segments of the abdomen, and from *Paguristes* in the chelipids being very unequal and the external maxillipeds widely separated at their bases,—in both of which characters it agrees with *Eupagurus*. The small size of the eyes, the great length of the antennulæ and antennæ, and the narrowness of the sternum between the bases of the second and third pairs of cephalothoracic legs, are apparently additional generic characters.

*Parapagurus pilosimanus*, sp. nov.

*Male.* The carapax is divided by the deep cervical suture, which is arcuate,—not in the form of a truncated V with irregular sides, as in *Eupagurus*. The anterior portion is slightly broader than long, smooth, and almost entirely naked. The anterior margin is more nearly straight than in the species of *Eupagurus*, but projects in a well-marked, though broad and obtuse, rostrum, each side of which the margin is straight to the lateral margin, except a very slight prominence between the bases of the eye-peduncles and antennæ. The posterior portion of the carapax is but little broader than the anterior portion and is only slightly expanded posteriorly.

The eye-peduncles are slender, taper distally, are scarcely as long as half the width of the front of the carapax, and are clothed with long hairs along the upper side. The cornea is very small, almost wholly terminal, and the pigment black. The ophthalmic scales are small, spiniform, slender, and acute.

The peduncles of the antennulæ are very long and slender; the proximal segment is about as long as the eye-peduncle; the second and third are nearly cylindrical, though the second is slightly compressed laterally, smooth, and almost perfectly naked; the second is about as long as the first, and the third fully twice as long. The dorsal, or major, flagellum is more than three-fourths as long as the distal segment of the peduncle, is composed of about forty segments, tapers to a very long and slender tip, and is densely clothed beneath with hairs. The inferior, or minor, flagellum is very slender, about half as long as the superior, and composed of eight or nine segments. The peduncles of the antennæ reach to the distal end of the second segment in the antennular peduncle, and the segments have pretty nearly the same form and proportions as in *Eupagurus bernhardus*. The acicles reach to the tips of the peduncles and are densely hairy above, while the rest of the peduncle is smooth and nearly naked. There is no tooth or spine at the inner side of the base of the acicle, but outside the base there is a prominent dentiform lobe denticulated at its extremity. The flagella of the antennæ extend far beyond the long ambulatory legs, are very slender, smooth, and almost entirely naked.

As seen from without, the inner oral appendages do not differ essentially from the corresponding parts in *Eupagurus*. The three or four distal segments of the endognaths of the external maxillipeds are, however, more cylindrical and a little more slender than in *Eupagurus bernhardus*.

The right cheliped is stout and about as long as the whole body of the animal. The propodus is minutely tubercular and somewhat pubescent on the outer and under sides, which together form a continuous and strongly convex surface; the inner inferior angle is armed with small tubercles, but the distal margin, along the articulation with the carpus, is smooth and unarmed. The carpus is almost as long as the basal portion of the propodus, subcylindrical, without lateral angles, and its whole surface minutely tubercular and clothed with dense, but very fine and soft, light-colored pubescence. The basal portion of the propodus is pretty nearly as broad as long, flattened vertically, evenly convex above and below, with the lateral margins rounded, and the whole surface, except a small space near the base beneath, as well as the basal portion of both fingers, tuberculated and clothed like the surface of the carpus. The digital portion of the propodus is rather slender and tapers rapidly to the calcareous tip, so that its prehensile edge has an oblique direction toward the right. The dactylus corresponds in form with the digital portion of the propodus and is about as long as the inner margin of that segment. The prehensile edges of both fingers are nearly straight and armed with a few, low and obtuse tubercles. The left cheliped is very slender, about three-fourths as long as the right, and the carpus and propodus are less tubercular than in the right, but are clothed with a similar dense pubescence. The propodus is but little longer than the carpus, is scarcely as broad and considerably thinner. The digital portion, as well as the dactylus, is nearly as long as the basal, slender, and slightly curved downward at the tip. The tips of both fingers are horny, their prehensile edges sharp, but the rest of the surface rounded and naked, except for the scattering fascicles of short setæ arising from little pits in the surface.

Both pairs of ambulatory legs reach far beyond the tip of the right cheliped and, except the dactyli, are smooth and almost entirely naked. The second pair are a little longer and slightly stouter than the first but do not differ in other respects. In both pairs the carpal segments are about half as long as the meral and reach to the distal extremity of the carpus of the right cheliped; the propodal segments are slightly longer than the meral. The dactyli are considerably longer than the propodi, slender, strongly curved, particularly toward the very slender and acute tips; they are compressed laterally, the sides being nearly smooth and naked and having a very shallow, longitudinal groove extending to the strongly curved terminal portions which are still more compressed and very

slightly twisted; the inferior edge, and the superior, except on the terminal portion, are rounded, and the superior has a few scattered setæ which become more numerous and regular near the tip, where the edge is compressed and sharp for a short distance. All the distal portion of each of the short fourth and fifth pairs of cephalothoracic legs have the same form and structure as in *Eupagurus bernhardus*, but are a little less hairy.

The sternal plates between the bases of the ambulatory legs are very narrow, the bases of the first pair being nearly contiguous, and those of the second separated by a triangular plate longer than broad and with its posterior margin excavated. The sternal portion of the penultimate segment of the cephalothorax is much broader than that in front of it, but the calcareous plate, as in *Eupagurus*, is a slender transverse rod, which is here much above the plain of the sternal plates in front, so that the coxæ of the penultimate pair of legs project abruptly much below it. The sternal portion of the posterior segment does not differ essentially from the same part in *Eupagurus bernhardus*. The inferior edges of the coxæ of the posterior pair of legs, however, are compressed below and the sexual orifices are in the posterior side instead of in the ventral edge.

The sternal portion of the first segment of the abdomen is closely united with the corresponding part of the last cephalothoracic segment, and the first pair of male appendages arise near together and almost between the coxæ of the posterior cephalothoracic legs. This first pair of male appendages, in the single specimen here described, are about  $7\frac{1}{2}^{\text{mm}}$  long and each is composed of a single plate, slightly thickened toward the base, but the distal half expanded into a thin lamella which is rolled into a slightly tapering half tube with its concavity facing inward and posteriorly. The second pair of appendages arise from the sides of the abdomen a considerable distance behind the first pair and are consequently widely separated at their bases. Each one is about  $11\frac{1}{2}^{\text{mm}}$  long and composed of a cylindrical basal segment to which is articulated a somewhat longer lamellar terminal segment; this terminal segment (which is so arranged that, when applied to the grooved surface of the corresponding appendage of the first segment, they together form a tube) has, on its anterior side, a shallow groove which terminates on the outer side of the appendage at a point a little way from the tip, and beyond this point the extremity of the appendage narrows into a slender, pointed and hairy tip.

The appendages of the left side of the third, fourth and fifth abdominal segments, as in the males of *Eupagurus*, are each com-

posed of a short basal portion, a linear outer lamella about three times as long as the base, and a very slender and minute inner lamella. The appendages of the sixth segment show nothing to distinguish them from the corresponding appendages in the species of *Eupagurus*. The telson is about as long as broad and its posterior margin is arcuate and only very slightly emarginate in the middle.

*Measurements.*

Length from front of carapax to tip of abdomen,	-	-	-	-	60·mm
“ of carapax along median line above,	-	-	-	-	21·7
“ “ from front to cervical suture,	-	-	-	-	13·4
Breadth of carapax at bases of antennæ,	-	-	-	-	12·0
Length of eye-peduncles,	-	-	-	-	6·3
“ peduncle of antennula,	-	-	-	-	22·0
“ ultimate segment of same,	-	-	-	-	11·2
“ major flagellum “	-	-	-	-	9·0
“ minor “ “	-	-	-	-	5·0
“ peduncle of antenna beyond front,	-	-	-	-	11·0
“ flagellum of antenna,	-	-	-	-	110·
“ chelipeds,	-	-	-	right, 61·	left, 45·
“ carpus in chelipeds,	-	-	-	18·	12·
“ propodus in chelipeds,	-	-	-	26·	15·
Breadth of “ “	-	-	-	13·7	6·5
Length of dactylus. “	-	-	-	14·0	8·7
“ first ambulatory leg, left side,	-	-	-	-	83·
“ propodus of same,	-	-	-	-	20·
“ dactylus “	-	-	-	-	27·8
“ second ambulatory leg, left side,	-	-	-	-	90·
“ propodus of same,	-	-	-	-	24·
“ dactylus “	-	-	-	-	32·5

Of this remarkable species I have seen only a single specimen, received, after the first part of this paper was in type, from Mr. Daniel McEachern, schooner “Guy Cunningham,” Gloucester, Massachusetts. It was taken, probably upon a trawl line, in 250 fathoms, hard bottom, off the coast of Nova Scotia, nearly due south of Halifax, north latitude  $42^{\circ} 41'$ , west longitude  $63^{\circ} 6'$ , and was inhabiting a peculiar compound actinoid polyp, which had evidently first grown upon the spiral gasteropod shell inhabited by the crab, afterward extended far beyond the shell, which it has very nearly or quite absorbed, and continued its growth rudely in the form of the original shell; very much as *Epizoanthus Americanus* forms spiral cases inhabited by *Eupaguri*.

**Munadopsis curvirostra** Whiteaves.

American Journal of Science, III, vol. vii, p. 212 (3), 1874; Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873], p. 17, [1874?].

Gulf of St. Lawrence!, 180 to 220 fathoms (J. F. Whiteaves).

**Homarus Americanus** Milne-Edwards.

New Jersey! (1871) to the Gulf of St. Lawrence! (Whiteaves) and reported as rare at Henley Harbor (just north of the Straits of Belle Isle), coast of Labrador, by A. S. Packard, Jr.

**Axius serratus** Stimpson.

Plate X, figures 4, 4a.

The original specimen described by Dr. Stimpson (Proceedings Boston Soc. Nat. Hist., iv, p. 222, 1852) is preserved, in a dried state, in the collection of the Peabody Academy of Science, Salem. Stimpson states that it was taken, by Mr. S. Tufts, of Lynn, in 20 fathoms, off Sitate, a town upon the southern shore Massachusetts Bay. The only specimen I have seen is a partially digested one found in the stomach of a flounder (*Glyptocephalus cynoglossus*), taken about five miles southeast from Cape Ann, 42 fathoms, mud, August 15, 1878. The species will very likely prove to be identical with the European *S. stirynechus*.

The specimen figured is the one originally described by Stimpson.

**Calocaris Macandréæ** Bell.

History of British Crustacea, part v, p. 233, fig., 1847.—Goes, Crustacea decapoda podophthalma marina Sueciæ, Æfversight af Kongl. Vetenskaps-Akad. Förhandlingar, 1863, p. 167 (7).—G. O. Sars, Hardangerfjordens Fauna, part i, Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 259 (16); Om en hidtil lidet kjendt mærkelig Slægtstype af Polyzoer, Christiania Videnskabs-Selskabs Forhandlingar, 1873, pl. 9, fig. 1.—Whiteaves, American Journal of Science, III, vol. vii, p. 212 (3), 1874.—Report on further Deep-Sea Dredging Operations in the Gulf of St. Lawrence [in 1873], p. 17, [1874?].

Gulf of St. Lawrence, 190 fathoms, mud, twenty miles southwest of the southwest point of the island of Anticosti (Whiteaves). On the European coast it has been found in deep water about the British Islands and on the coasts of Scandinavia. I have seen no specimens.

**Crangon vulgaris** J. C. Fabricius ex Linné.

Fort Macon!, North Carolina (Coues, Packard). New Jersey! 1871. South shore of Long Island!, 1870. Abundant along the whole New England coast, from low-water mark to 30 fathoms or more, but somewhat less numerous north of Massachusetts Bay. Stellwagen's Bank!, 34 fathoms, sand, 1873. Massachusetts Bay!, off Salem, 20 fathoms, rocks and gravel, and 48 fathoms, soft mud, 1877. In the region of George's Bank!, 28, 30 and 45 fathoms, sand, 1872. Halifax!, Nova Scotia, abundant and very large at or near low water, and dredged in 16 and 18 fathoms, on bottoms of sand,

sand and mud, fine sand and red algæ, stones and red algæ, and rocks. Gulf of St. Lawrence!, "common everywhere in shallow water and at low-water mark on most sandy beaches" (Whiteaves). Caribou Island, Straits of Belle Isle (Packard). From the northern part of the Norwegian coast (Sars) to the Baltic (Möbius), North Sea (Metzger), British Islands! (Norman), and south to the north shores of the Mediterranean (Heller, et al.).

This species is found in greatest abundance in shallow water and on sandy or weedy bottoms, but occurs also on muddy, shelly and rocky bottoms, and extends at least to about 50 fathoms in depth.\* It varies very much in coloration according to the location in which it is found. Upon the exposed and light-colored sandy shores of southern New England, specimens are invariably translucent and very pale in color so as to closely resemble the surface upon and beneath which they live, while upon dark-colored muddy bottoms they are very much darker in color. Specimens from a dark-colored muddy inlet of Vineyard Sound and others from dark muddy and sandy bottom at Halifax, Nova Scotia, are very dark indeed, the pigment spots covering nearly the entire surface, and the caudal appendages becoming almost black toward the tips.

*Crangon boreas* J. C. Fabricius ex Phipps.

Massachusetts Bay!, off Salem, 22 fathoms, gravelly bottom, 1877. Stellwagen's Bank!, fifteen to seventeen miles south-southeast from Cape Ann, 23 to 33 fathoms, gravel, stones and sponges, 1878,—common and of large size, one female being 63<sup>mm</sup> in length. Casco Bay!, from stomachs of codfish taken on West Cod Ledge, and a single specimen dredged near the Ledge in 10 to 20 fathoms, rocky bottom, 1873. Bay of Fundy!, occasionally taken among rocks at low water!; common in 5 to 25 fathoms, rocky, gravelly, and shelly bottoms; and abundant at special localities in Johnson's and South

\* According to my own observations, this species is very rare at depths greater than 45 fathoms and I have no positive evidence of its occurrence below 48 fathoms. There is, however, in the collections made off Cape Ann, in 1878, a single, small specimen, unquestionably of this species, which is labeled as having been dredged in 140 fathoms, soft mud, about forty miles east by south from Cape Ann. The specimen was alone in a vial when received and there may have been some mistake in the labeling, or it may have been taken among floating sea-weeds. My statement (Invertebrate animals of Vineyard Sound, Report of the U. S. Commissioner of Fish and Fisheries, part i, p. 550 (256)) that this species "extends from low water to 60 or 70 fathoms," was probably carelessly made from memory. Kingsley (Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 89 (1)), states that it is "common in 70 fathoms," without, however, giving any special locality or authority.

Bays, in 10 to 15 fathoms, on rocky bottoms overgrown with sponges, ascidians, hydroids, algæ, etc.; 1864, 1868, 1870, 1872, 1876. Halifax!, Nova Scotia, 1877: 18 fathoms, fine sand; 20 fathoms, shingly; and 25 fathoms, gravelly. Orphan Bank!, and off Cape Bon Ami, Gulf of St. Lawrence (Whiteaves). Square Island!, coast of Labrador, 15 to 30 fathoms (A. S. Packard, Jr.) Coasts of Grinnell Land and Greenland as far north as latitude  $81^{\circ} 44'$  (Miers). East coast of Greenland (Buchholz). Iceland (Kröyer). Along the whole coast of North America to Bering Straits (Stimpson) and the Siberian coast (Brandt). Spitzbergen (Goës). Finmark (M. Sars). Lofoten Islands!, coast of Norway (G. O. Sars).

Robert Bell, Jr. (Canadian Naturalist and Geologist, iv, p. 210, 1859) records "a specimen corresponding nearly with Bell's description" of *Crangon sculptus*, from off Cape Chatte, Gulf of St. Lawrence, but was probably mistaken in the identification of the species, having had most likely *Crangon boreas*, or perhaps one of the species of *Sabinea*.

#### *Sabinea septemcarinata* J. C. Ross.

*Crangon septemcarinatus* Sabine, Supplement to the Appendix of Parry's first Voyage, p. ccxxxvi, pl. 2, figs. 11-13, 1824.—Milne-Edwards, Hist. nat. des Crust., ii, p. 343, 1837.—(?) Brandt, Middendorff's Sibirische Reise, Kriebse, p. 114 (Davis' Straits).

*Sabinea septemcarinata* J. C. Ross, in J. Ross, Appendix to the narrative of a second Voyage in search of a northwest passage, p. lxxxii, 1835.—(?) M. Sars, Christiania Videnskabs-Selskabs Forhandling for 1858, p. 125, 1859 (coast of Norway).—(?) Stimpson, Proceedings Academy Nat. Sci. Philadelphia, 1860, p. 25 (94) (Arctic Ocean near Siberia).—(?) Packard, Memoirs Boston Soc. Nat. Hist., i, p. 302, 1867 (Thomas Bay, coast of Labrador).

*Sabinea* (*Crangon*) *septemcarinata* Kröyer, Naturhistorisk Tidsskrift, iv, p. 244, pl. 4, figs. 34-40, and pl. 5, figs. 41-44, 1842. (Not *Crangon septemcarinatus* Kröyer, Grönlands Amfipoder, p. 314 (86), 1838; and Naturhistorisk Tidsskrift, ii, p. 252, 1838).

Plate XI, figures 5, 9, 10, 11, 12, 13.

Two distinct species have been confounded under the name *septemcarinata*. In one of these the rostrum as seen from above is short and obtusely rounded at the tip, and the extremity of the telson is subtruncate and armed with a series of eight or more spines or stout setæ; in the other species the rostrum is acutely pointed and the telson terminates in an acute tip, with one or two spines each side. Sabine's original description and figures show very plainly that he had the first of these species, and to this species also Kröyer's figures and descriptions, above referred to, apply. I have, however, received, from Professor G. O. Sars of Christiania, both species under the name

*septemcarinata*, from the coast of Norway, and I have myself recorded, under the same name, specimens of the second species, taken by Mr. Harger and myself upon Le Have and St. George's Banks in 1872.

Of the *septemcarinata* there are over one hundred specimens before me, and all of them agree very closely in the form of the rostrum and telson, and in the armament and sculpturing of the carapax and abdomen. The rostrum is nearly horizontal, scarcely overreaches the eyes when they are directed forward, is obtusely rounded at the extremity as seen from above, and has a median dorsal carina which is most prominent near the tip. The dorsal carina of the carapax is well marked, but the teeth with which it is armed are not very prominent and in none of the specimens are there more than five in all. Of these spines the anterior is minute and scarcely forms a part of the carina, the second, third and fourth are about equal in size, while the fifth is smaller and very near the posterior margin, or wholly wanting in some of the smaller specimens. The subdorsal carinæ are distinct and irregularly dentate posteriorly, but on the anterior third of the carapax are faintly indicated and not at all, or only very obscurely, dentate. The superior lateral carinæ terminate anteriorly in a short tooth at the outer angle of the orbit but are not distinctly dentate near the anterior border of the carapax. The inferior lateral carinæ are strongly dentate anteriorly but posteriorly the teeth become very small or even obsolete.

The telson falls considerably short of, or reaches nearly to the tips of, the inner lamellæ of the uropods. Its extremity is truncated,—or rather terminates in a very obtuse and rounded angle,—and is usually armed with ten to fourteen slender spines or spiniform setæ. This armament of the tip of the telson is subject to considerable variation, apparently for the most part due to wear or to accidental injuries of various kinds; but there seems to be no approach to the structure in the next species. The number of spines slightly in different specimens but consists regularly of an even number—there being no median spine,—those cases where there is an odd number being apparently the result of accident. In small specimens which are very little worn, the spines are slender and vary much in length, the outer ones being short while those toward the center are very long, often fully equal in length to the breadth of the extremity of the telson, and ciliated toward their tips. This perfect form of armament is well shown in the specimen of a male figured (Plate XI, figure 10) and, in the specimens examined, seems to be more common among the males, although some of the young females have it in nearly as great per-

fection. In large specimens and those which are slightly worn the spines are usually much shorter, stouter and more uniform in length, and show scarcely any trace of ciliation (Plate XI, figure 11). In specimens considerably worn the spines are, of course, frequently partially or wholly destroyed.

The males are much smaller than the females; the largest male, among the specimens examined, is 45<sup>mm</sup> in length and the largest female, 72<sup>mm</sup>, which represents very nearly the average difference in size. In the armament of the carapax and of the extremity of the telson the sexes agree perfectly. The males are at once distinguished from the females, however, by the longer flagella of the antennulæ and antennæ.

Massachusetts Bay!, 1877, common in 35, 48, and 50 fathoms, muddy bottom, August 6 to 10,—many of the females carrying eggs; and taken also in 20 fathoms, rocks and gravel, and 36 fathoms, mud and fine sand. Off Cape Ann!, 1878, in 26 to 60 fathoms, common on muddy bottoms, and occasionally on sandy, pebbly and rocky bottoms. Gulf of Maine!, off the Isles of Shoals, 25 fathoms, rocky, 1874, and eight miles south of Monhegan Island, 64 fathoms, mud and sand, 1873,—only a single very small specimen in each case. Off Casco Bay!, twenty miles southeast of Cape Elizabeth, 68 fathoms, mud, August 12, 1873,—two females, one carrying eggs. Off Halifax!, Nova Scotia, 1877, 52 fathoms, fine sand and mud, September 21,—common; 57 fathoms, mud, gravel and stones, September 5,—two females, one carrying eggs. Gulf of St. Lawrence!, 60 fathoms, 1872 (J. F. Whiteaves). West coast of Davis' Straits (Sabine). Greenland (Reinhardt, Lütken). Iceland (Krøyer). Spitzbergen (Krøyer). Lofoten Islands!, coast of Norway (G. O. Sars),—one male with two large females of the next species.

*Sabinea Sarsii*, sp. nov.

Plate XI, figures 6, 7, 8.

The eyes, antennulæ, and the thoracic appendages differ very slightly if at all from those of the last species; the lateral squami-form appendage of the first segment of the pedicel of the antennula, in all the specimens examined, is, however, more prominent and acute than in *septemcarinata*. The rostrum reaches considerably beyond the eyes and, as seen from above, terminates in an acute tip. The dorsal carina of the rostrum is sharper and higher than in the last species and extends to the very tip, which is obtusely rounded as seen laterally. The dorsal carina of the carapax is sharper and its teeth more prominent, and usually more numerous, than in the last species.

The subdorsal carinæ are distinct and distinctly, and pretty regularly, dentate throughout. The superior lateral carinæ are better marked than in the last species and terminate in an acute and prominent tooth at the outer margin of the orbit, and just back of this there is a distinct tooth in the carina itself. The elaborate sculpturing of the dorsal surface of the abdomen, though apparently after the same pattern as in *septemcarinata*, is much more distinct and conspicuous.

The telson, in all the specimens seen, reaches to or slightly beyond the tips of the inner lamellæ of the uropods. The distal portion is a little more slender than in the last species and the dorsal aculei appear slightly more conspicuous. In adult specimens, the extremity terminates in an acute tip much longer than its breadth at base, where it is separated from the body of the telson by an emargination each side, from each of which arise two spines, a large inner one with a minute one outside at its base; this is the structure in the two perfect adult specimens examined, the larger of the two females from the coast of Norway (Plate XI, figures 6*b*, 6*c*) and a smaller individual of the same sex from the Gulf of Maine, 1877, (Plate XI, figure 7). In a very small specimen, only 16<sup>mm</sup> in length, from St. George's Banks (Plate XI, figure 8), and in a still smaller specimen from Le Have Bank, the extremity of the telson is acutely triangular and armed each side with three slender spines of nearly equal length,—evidently an approach to the early stages of the young.

St. George's Banks!, 60 fathoms, shells and sand, 1872,—one young specimen 16<sup>mm</sup> in length. Gulf of Maine!, about east-southeast from Cape Sable, Nova Scotia, latitude 42° 40' north, longitude 66° 58' west, 112 fathoms, gravel, August 20, 1877,—one female 36<sup>mm</sup> in length. Le Have Bank!, 60 fathoms, coarse gravel, stones and sponges, September 12, 1872,—a female, 47<sup>mm</sup> in length, carrying eggs, and a small specimen badly mutilated. Lofoten Islands!, coast of Norway (G. O. Sars),—two fine females, 62 and 53<sup>mm</sup> in length.

I take great pleasure in associating the name of Professor G. O. Sars with this species.

#### *Pontophilus Norvegicus* M. Sars.

"*Crangon Norvegicus* M. Sars, Beretning om en zoologisk Reise ved Kysten af Romsdals Amt i Nyt Magazin f. Naturv., 11 B., 1861, p. 8" (Sars).—Goës, Æfversight af Kongl. Vetenskaps-Akademiens Förhandlingar, Stockholm, 1863, p. 173 (13).

*Pontophilus Norvegicus* M. Sars, Christiania Videnskabs-Selskabs Forhandling, 1861, p. 183; Bidrag til Kundskab om Christianiafjordens Fauna (extr. Nyt Mag-

azine for Naturvidenskaberne), p. 2, pl. 1, figs. 1-25, pl. 2, figs. 17-37, 1868.—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt Mag. Nat.), p. 14, 1866; Undersøgelser over Christianiafjordens Dybvandsfauna (extr. Nyt Mag. Nat.), p. 17, 1869; Christiania Videnskabs-Selskabs Forhandlinger, 1871, p. 261 (18), 1872—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 291, 1875.

Gulf of Maine!, about thirty miles east-southeast from Cape Ann, 115 fathoms, mud, sand, gravel and stones, August 24 and 31, 1878,—four specimens, one female about 70<sup>mm</sup> long. Off the coast of Nova Scotia!, about thirty miles south of Halifax, 101 fathoms, fine sand, and 110 fathoms, fine sand and mud, September 6 and 20, 1877,—twenty-four specimens. It was previously known only from the Scandinavian coast. Coast of Norway!, 30 to 500 fathoms (G. O. Sars).

#### Nectocrangon lar Brandt ex Owen.

About twenty miles southeast from Cape Sable!, Nova Scotia, 59 fathoms, pebbles, sand and rocks, 1877. Common in Bedford Basin!, Halifax, Nova Scotia, 26-41 fathoms, mud, and also about ten miles off Halifax!, 52 fathoms, fine sand and mud, 1877. Gulf of St. Lawrence! (J. F. Whiteaves). St. Johns, Newfoundland (Stimpson). Labrador! (A. S. Packard, Jr.). Greenland (Krøyer, Norman). Bering Sea (Brandt, Stimpson). "Arctic Ocean" (Owen, Stimpson).

#### Caridion Gordoni Goës.

"*Hippolyte Gordoni* Bate, Nat. Hist. Review, v, p. 51." (Norman.)

*Doryphorus Gordoni* Norman, Annals and Magazine of Nat. Hist., III, viii, p. 277, pl. 13, figs. 6, 7, 1861 (from Moray Firth); Report British Assoc. Advanc. Sci., 1868, p. 265 (Shetland Isles). The name *Doryphorus* is preoccupied, having been used by Cuvier in 1829 for a genus of reptiles.

*Caridion Gordoni* Goës, Crustacea decapoda podophthalma marina Suecicæ, (Efter-sigt af Kongl. Vetenskaps. Akad. Förhandlingar, 1863, p. 170 (10), 1863.—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter, p. 13, 1866; Undersøgelser over Christianiafjordens Dybvandsfauna, p. 21, 1869; Christiania Videnskabs-Selskabs Forhandlinger, 1871, p. 261 (18), 1872.—Smith, Transactions Connecticut Acad., iii, p. 28, 1874.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 290, 1875.

Off the coast of New Hampshire, between the Isles of Shoals and Jeffrey's Ledge!, 51 fathoms, mud and gravel, 1874. Casco Bay!, from the stomach of cod taken on West Cod Ledge, August 21, 1873,—a female carrying eggs. Gulf of Maine!, on and near Cashe's Ledge, 27 and 40 fathoms, rocks and gravel, 1874, and south of the

Ledge, in 52 to 90 fathoms, rocky, 1873,—common. Near St. George's Banks!, 110 fathoms, "sand and mud with a few stones," 1872,—one young specimen. Bay of Fundy!, 40 to 50 fathoms, rocky, Aug. 14, 1868,—a female carrying eggs; and off White Head, Grand Menan, 40 to 50 fathoms, 1872. On the European coast it has been recorded from Scotland! (Norman), the North Sea (Metzger), and the west coast of Norway!, 150 to 200 fathoms (G. O. Sars).

As the above record of stations shows, this species is an inhabitant of hard, and usually rocky, bottoms in deep water. This is probably the reason of its apparent rarity, since such localities are not common and are difficult of exploration with the dredge.

European specimens, received from the coast of Norway through Prof. G. O. Sars, agree with all the American specimens examined in having well developed epipodi at the bases of the second, third and fourth cephalothoracic legs, as well as in all other respects. The dentition of the rostrum is subject to considerable variation. In twenty-two specimens examined, varying from 17 to 27<sup>mm</sup> in length, four had the formula,  $\frac{6}{1}$ ; seven,  $\frac{7}{1}$ ; nine,  $\frac{8}{1}$ ; one,  $\frac{9}{1}$ ; and one,  $\frac{7}{2}$ ;—each of the last two cases being adult specimens from Cashe's Ledge.

#### Hippolyte Leach.

In accordance with the rules for zoological nomenclature as at present generally accepted, the name *Hippolyte* should not be applied to the species now usually included under it and ought to be restored to the species without mandibular palpi, and for which Stimpson has proposed the new generic name *Virbius*.

The genus *Hippolyte*, as first proposed by Leach in 1813 or '14 (Edinburgh Encyclopædia, American edition, vol. vii, p. 271),\* contains but one species, *H. varians* Leach, and in 1815 in the Transactions of the Linnean Society, vol. xi, p. 347, *varians* is still retained as the first species and a new species, *inermis*, added. In the first of these publications there is, under *Hippolyte*, the observation that "to this genus the *Cancer Astacus gibbosus* of Montagu belongs," and in both of them the "*Cancer spinus* of Sowerby" is referred to *Alpheus*. In 1817, in the Malacostraca Podophthalmata Britannicæ, however, Leach says, "Montagu sent to me *Hippolyte varians*, the type of this genus, as his *Cancer astacus gibbosus*, but he afterwards informed

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\*I have not been able to examine the original edition. The American edition seems, however, at least as far as the article under consideration is concerned, to be an exact reprint of the original, with changes only in paging and division into volumes.

me, by letter, that his figure and description had been made from mutilated specimens, of what he had since ascertained to be a very distinct species, and requested me to take the earliest opportunity to correct his mistake," thus fully disposing of Montagu's species and unquestionably establishing *varians* as the type of the genus. In this last work the genus *Hippolyte* includes five species, as follows: *H. Prideauxiana* (apparently the same as the *inermis* mentioned above), *H. Moorii* (a variety of the last), *H. varians* (*Virbius varians* of Stimpson), *H. Chranchii*, and *H. Sowerbæi* (Leach's *Alpheus spinus*, here for the first time referred to *Hippolyte*).

Numerous other more or less allied species were added to the genus by subsequent authors, but little was added to our knowledge of the structure and real affinities of the species until the appearance of Kröyer's monograph, in 1842, in which many new arctic species were very fully described and figured and the structural differences between them made known. Kröyer's first section of the genus contained but one species, the *smaragdina*, apparently synonymous with Leach's *varians*. This section of the genus is equivalent to Stimpson's genus *Virbius* (Proceedings Acad. Nat. Sci. Philadelphia, xii, p. 35 (104), 1861), which is characterized specially by non-palpigerous mandibles, the absence of epipodal appendages upon the external maxillipeds and thoracic legs, and by the tri-articulate carpus of the second thoracic legs, and, as originally constituted, included *Hippolyte acuminata* Dana, *H. viridis* Milne-Edwards, *H. smaragdina*, *H. obliquimana* Dana, *H. exilirostrata* Dana, *H. varians*, and *H. Prideauxiana*, together with *Virbius Australiensis*, *acutus* and *Kraussianus* Stimpson. Stimpson's *Virbius* is thus seen to include the type and all the original species of Leach's genus, and, according to common practice, it should be made a synonym of that genus and a new name given to the larger division, which includes nearly all the arctic species, of the genus as used by Kröyer. Nothing but additional synonymy and confusion would result, however, and I therefore accept the generic names as they now stand.

#### *Hippolyte Fabricii* Kröyer.

Salem Harbor!, 6 fathoms, 1873. Massachusetts Bay!, off Salem, 1877: abundant in 19 to 30 fathoms, gravelly, stony and rocky bottoms; common in 35 fathoms, mud and clay nodules, and in 48 fathoms, soft mud. Off Cape Ann!, 50 fathoms, mud, gravel and stones, 1877. Common on Stellwagen's Bank!, 22 to 29 fathoms, rocky, and on Jeffrey's Ledge!, 24 and 33 fathoms, gravel and

stones, 1873. Between Cape Ann and the Isles of Shoals!, 27 to 36 fathoms, rocks and mud, and off the Isles of Shoals!, 35 fathoms, clay, mud and sand, 1874. Abundant in 7 to 35 fathoms, rocky, gravelly, shelly and muddy bottoms, at various localities in Casco Bay!, and taken also near low water mark, among eel-grass!, in Portland Harbor, and a single specimen from 48 to 64 fathoms, stones and mud, sixteen to eighteen miles east-southeast Portland Light!, 1873. Found also in abundance in the stomachs of the cod taken on West Cod Ledge!, off Portland. Bay of Fundy!, 1864, 1868, 1870, 1872, 5 to 40 fathoms, but not found in so great abundance as in Casco and Massachusetts Bays. Large females carrying eggs were also collected at Eastport!, Maine, by C. Hart Merriam and E. B. Wilson, in April, 1876. Halifax! Nova Scotia, 1877, common in 16 to 21 fathoms, stones, sand and red algæ; in 18 to 25 fathoms, shingly, gravelly, sandy and muddy bottoms; and 16 fathoms, mud, at the mouth of Bedford Basin; and a single specimen, in company with *H. macilenta*, in 35 fathoms, very soft mud, in Bedford Basin itself. Also off Halifax!, 52 fathoms, sand, mud and rocks, and 57 fathoms, gravel and stones, 1877. Gulf of St. Lawrence!, 1871, (J. F. Whiteaves). Labrador! (A. S. Packard, Jr.) Greenland (Krøyer, Norman, et al.) Bering Sea (Stimpson).

Mr. Kingsley (List of the North American Crust. belonging to the Sub-order Caridea, Bulletin Essex Institute, vol. x, p. 59, 1878) gives "Massachusetts Bay northward to Europe" for the distribution of this species, but, as this is the only record I have been able to discover of its occurrence on the eastern side of the Atlantic, I am inclined to regard it as an error, although its discovery in Europe may very properly be expected.

A careful examination of a large series of specimens of this species shows considerable variation, even in characters which are usually regarded of at least specific value. The most important of these variations which I have noticed is—

*The presence or absence of epipodi upon the bases of the second pair of cephalothoracic legs.* The *Fabricii* differs from all the other species of the genus which I have examined in usually wanting epipodi at the bases of all the cephalothoracic legs except the first pair, while in the other species these appendages are usually present upon the bases of the first and second or upon the first, second and third pairs; and on this character it was placed alone in a section of the genus by Krøyer. Among fifty-two individuals (eighteen males varying in length from 27 to 39<sup>mm</sup>, and thirty-four females varying

from 16.5 to 50<sup>mm</sup>), from various localities on the New England coast, forty-seven had the normal number of epipodi, while five had epipodi upon one or both of the second pair of legs. Three of the latter are from the Bay of Fundy: one, a male 35<sup>mm</sup> long, has well-developed epipodi on each of the second pair of legs; another male, 36<sup>mm</sup> long, has a short epipodus on the left side but none on the right; the other specimen, a female 47<sup>mm</sup> long, has a well-developed epipodus on the right side but none on the left. The two others are from Casco Bay: a female, 36<sup>mm</sup> long, with a short epipodus on the left side, and a male, 28<sup>mm</sup> long, with a rudimentary one on the right side. As the measurements of these specimens show, the presence of the additional epipodi is not a characteristic of the young.

The number and position of the teeth upon the rostrum and dorsal carina of the carapax vary considerably more than is usually indicated in the descriptions of the species and yet are very characteristic specifically. Except as a result of injury, the tip of the rostrum is always acute and without teeth, and there are never teeth upon the dorsal margin except near the base. The most usual formula for the dentition is  $\frac{3+1}{3}$  or  $\frac{2+2}{3}$ , the third dorsal tooth being usually just above the base of the rostrum; in the series of specimens examined,

Formula.	Number of specimens and variation in length.		
	Males.	Females.	Total.
$\frac{3+1}{3}$ or $\frac{2+2}{3}$	45, from 16 to 39 <sup>mm</sup>	45, from 16.5 to 50 <sup>mm</sup>	90
$\frac{3+1}{2}$ or $\frac{2+2}{2}$	14, " 15 " 35 "	16, " 15 " 40 "	30
$\frac{3+1}{4}$ or $\frac{2+2}{4}$	8, " 22 " 33.5 <sup>mm</sup>	8, " 15.5 " 50 "	16
$\frac{3+2}{3}$ or $\frac{2+3}{3}$		8, " 27 " 40 "	8
$\frac{2+1}{3}$ or $\frac{3+0}{3}$	1, 30 "	8, " 20 " 37.5 "	9
$\frac{2+1}{4}$	2, 27 and 32 "		2
$\frac{3+2}{4}$		2, 40 and 44 "	2
$\frac{2+2}{5}$		1, 31 "	1
$\frac{2+3}{6}$		1, 30 "	1
$\frac{3 \text{ to } 5}{2 \text{ to } 6}$	70	89	159

however, the number of teeth varies from three to five above and from two to six beneath, although the extremes of these variations seem to be of rare occurrence, as the accompanying tabular summary of the result of the examination of one hundred and fifty-nine specimens shows.

This result is, perhaps most noticeable for showing the constancy of what seems a very trivial character, for, among all the specimens examined, not one varies more than a single tooth either above or below the most usual number upon the dorsal carina and only two specimens (the last in the table) exceed this amount of variation in the number of teeth in the ventral edge of the rostrum.

One specimen, not included in the above summary, has the rostrum slightly distorted and bifid at the tip as seen from above,—a peculiarity undoubtedly due to injury, though there is nothing but a slight lateral distortion to indicate such a cause.

The two *spines of the anterior margin of the carapax* are usually both well-developed, but the inferior one (the pterygostomial) is occasionally very minute or even entirely obsolete. This obsolescence was noticed only in adult males, and is apparently an approach to the usual entire disappearance of the same spines among the old males of *Hippolyte polaris*.

The *dorsal aculei and terminal spines of the telson* appear to be very constant in character and number. Among seventy-five specimens examined with reference to the dorsal aculei of the telson, sixty-nine had either four or five pairs, or four upon one side and five upon the other. Of the six remaining, four are young and have less than the normal number for adults, a male 15<sup>mm</sup> long and a female 16.5<sup>mm</sup> having only three pairs of aculei each, another male 15<sup>mm</sup> and a female 17<sup>mm</sup> having each three on one side and four on the other; while a male 32<sup>mm</sup> long has also less than the normal number, having three on one side and four on the other, and a female 27<sup>mm</sup> has more than usual, having five upon one side and six upon the other. Fifty specimens examined with reference to the armament of the tip of the telson all had the normal number of spines,—two slender and ciliated ones in the middle with two stouter ones each side.

The largest specimens examined were taken in the Bay of Fundy, the largest males being 39<sup>mm</sup> long and the largest females 50<sup>mm</sup>.

The only specimens I have seen carrying eggs were collected at Eastport, Maine, in April, 1876, by Messrs. Merriam and Wilson. Among over a hundred adult females taken from July to late in October, none were carrying eggs.

**Hippolyte Gaimardii** Milne-Edwards.

*Hippolyte Gaimardii* Milne-Edwards, Hist. nat. des Crust., ii, p. 378, 1837.

*Hippolyte pandaliformis* Bell, History of British stalk-eyed Crustacea, p. 294 [1850?]

*Hippolyte Belcheri* Bell, in Belcher, Last of the Arctic Voyages in search of Sir John Franklin, vol. ii, p. 402, pl. 34, fig. 1, 1855.

## Plate IX, figures 8 and 9.

Boston Harbor, 3 fathoms, and other parts of Massachusetts Bay (Stimpson). Casco Bay!, among algæ and eel-grass near low-water mark, and also in 7 fathoms, mud and dead eel-grass, 1873. Eastport!, Maine, 1864,—one specimen only. Halifax!, Nova Scotia, 16 and 21 fathoms, stones, sand and red algæ, and 18 fathoms, fine sand and mud, 1877. Also off Halifax!, 52 fathoms, mud and fine sand, and 57 fathoms, mud and pebbles, September, 1877,—one specimen from 57 fathoms carrying eggs. Gulf of St. Lawrence!, “50 fathoms, stony and rocky,” and “56 fathoms, stones and coarse sand,” 1872 (J. F. Whiteaves). Labrador!, “common on the whole coast” (Packard). Grinnell Land, 79° 29' north latitude, (Miers). Bering Straits and Arctic Ocean (Stimpson),—*H. gibba* Kröyer. Greenland (Kröyer, et al). Iceland (Milne-Edwards, G. O. Sars). Spitzbergen (Kröyer, Miers). The whole Norwegian coast (Kröyer, et al.), the Cattegat (Kröyer), to the southern Baltic, at Kiel (Möbius, Metzger). Scotland! (Norman).

Of the twenty-five specimens which I have examined only five are males, and none of these have the remarkable dorsal prominence of the third segment of the abdomen characteristic of *H. gibba* Kröyer. None of these males, however, are over 30<sup>mm</sup> long, and still in the largest of them, there is a slight carination of the third segment of the abdomen as if presaging the conspicuous character of the typical *gibba*, so that I have no reason to doubt the correctness of Goës' conclusion that Kröyer's *gibba* was based on old males of *H. Gaimardii*.

Milne-Edwards' “Troisième anneau de l'abdomen moins fortement denté,” which Stimpson (Annals Lyceum Nat. Hist. New York, x, p. 126, 1871) seems to regard as throwing doubt on the identity of Kröyer's *Gaimardii* with that of Milne-Edwards, may have referred to a young male like those just mentioned, although the fact that Milne-Edwards is comparing his species with *H. Sowerbyi* (*H. spinus*), would not necessarily imply any considerable angulation of the third segment of the abdomen. I think there is no reasonable doubt of the identity of Milne-Edwards' species with that of Kröyer and more modern authors.

The spines at the tip of the telson are normally of the same number and similar to those of *H. Fabricii*, and the terminal angle is usually very obtuse and rounded (Plate IX, figure 8). One specimen, however, out of the twenty-one in which the tip of the telson was examined, a female, 39<sup>mm</sup> long, from Casco Bay, has the tip of the telson (Plate IX, figure 9) acute and armed with three small ciliated spines in the middle in place of two, so that there are seven spines in all. In other respects this specimen is perfectly normal and indistinguishable from ordinary individuals. Similar variations are noticed under *H. polaris* and *H. pusiola* and well illustrate the difficulty of stating accurately the specific characters in this genus.

Specimens taken among algæ and eel-grass in Casco Bay were, in life, translucent, slightly tinged with greenish brown, and without brightly colored markings of any kind.

### Hippolyte spinus White.

*Cancer spinus* Sowerby, British Miscellany, p. 47. pl. 23, 1805.

*Alpheus spinus* Leach, "Edinburgh Encyclopedia, vii, p. 431, 1813-14" (Miers), American edit., vii, p. 271; Transactions Linnean Soc. London, xi, p. 347, 1815.

*Hippolyte Sowerbæi* Leach, Malacostraca Podophthalmata Britanniae, pl. 39, 1817.

*Hippolyte spinus* White, List Crust. British Museum, p. 76, 1847.—Bell, History of British Crustacea, p. 284 [1847?]

*Hippolyte spina* Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, xii, p. 34 (103), 1860; Annals Lyceum Nat. Hist. New York, x, p. 126, 1871.

Massachusetts Bay!, off Salem, 1877; 20 to 30 fathoms, gravel and rocks, common; 33 fathoms, sand and mud; 35 fathoms, mud and clay nodules, abundant; 33 fathoms, sand and mud; 48 fathoms, soft mud. Gulf of Maine!, off Cape Ann, 1877, 50 fathoms, mud, gravel and rocks; and 90 fathoms, soft mud, common. Abundant on Stellwagen's Bank!, 29 fathoms, rocky, and on Jeffrey's Ledge!, 24 and 33 fathoms, gravel and stones, 1873. Near the Isles of Shoals!, 25 fathoms, rocky, abundant, and between the Isles and Cape Ann!, 27 to 36 fathoms, mud and rocks, 1874. Cashe's Ledge!, Gulf of Maine, 27 and 40 fathoms, gravel and rocks, very abundant; and a little south of the Ledge, 52 to 90 fathoms, rocky, 1873, 1874. Casco Bay!, 1873, among stones, at low-water mark!, on Rau Island Ledge, and common in 10 to 35 fathoms, on rocky, gravelly and shelly bottoms; taken also in 9 fathoms, mud, off Fort Georges, Portland Harbor. Very abundant in the Bay of Fundy!, 1864, 1868, 1870, 1872, 1876, on all kinds of hard bottoms in 5 to 40 fathoms; taken also, in 1872, off Whitehead, Grand Menan, 40 to 50 fathoms, gravelly bottom; west of Grand Menan, 50 to 55 fathoms, gravel;

off Head Harbor, 77 fathoms, mud and stones; and found rarely at low-water mark, under stones. Le Have Bank!, 45 fathoms, gravel and stones, 1872,—one specimen with two of *H. securifrons*. Off Cape Negro!, Nova Scotia, 56 fathoms, large stones, 1877. Halifax!, Nova Scotia, 1877; 16 fathoms, stones, sand and red algæ; and off Halifax!, 42 fathoms, fine sand; 52 fathoms, fine sand, mud and rocks, abundant; and 57 fathoms, mud and stones. Gulf of St. Lawrence!, “common on stony ground at moderate depths” (Whiteaves). Labrador! (Packard). Greenland (Krøyer, et al.). Grinnell Land, and as far north as latitude 81° 44' (Miers). Bering Straits (Stimpson). Spitzbergen (Krøyer). Coast of Norway! (G. O. Sars) and of Scotland (Sowerby, Leach, et al.). This is by far the most abundant species of the genus on the New England coast.

Females carrying eggs were taken off Cape Ann, October 17; in the Bay of Fundy, at Eastport, in September or October, 1864, and, by Messrs. Merriam and Wilson, in April, 1876; one specimen off Halifax, Nova Scotia, September 5, and many September 21 and 27. I have seen no specimens taken in winter, but the period of carrying eggs undoubtedly extends from October to April or May.

In life this species is usually translucent and thickly mottled and spotted with bright red, brownish red and white, the flagella of the antennæ, the thoracic legs and the caudal appendages being annulated or banded with bright red. In some specimens the brownish red predominates and the animal is less translucent. There are other individuals in which larger or smaller portions of the cephalothorax are opaque white, these markings sometimes extending on to the abdomen or even upon the cephalothoracic appendages, but they are seldom regularly disposed and are sometimes quite unlike on the two sides of the same animal. Stimpson mentions bluish markings also, and says the antennal scales are usually blue, but I have never noticed such coloration.

### *Hippolyte securifrons* Norman.

“*Hippolyte securifrons* Norman, Transactions Tynside Naturalists' Field Club, v, p. 267, 1863” (Danielssen and Boeck, Metzger). Norman, in Brady, Report on deep sea dredging on the coasts of Northumberland and Durham, 1862-4, Nat. Trans. Northumberland and Durham, i, p. 24, 1865; Last Report on dredging among the Shetland Isles, Report British Assoc. Adv. Sci., 1868, p. 265.—G. O. Sars. Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt Magazin for Naturvidenskaberne), p. 13, 1866; Christiania Videnskabs-Selskabs Forhandling, 1871, p. 261 (18).

*Hippolyte Liljeborgii* Danielssen and Boeck, Beskrivelse af nogle til Crust. decapoda (extr. Nyt Magazin for Nat.), p. 8, pl., figs. 15–20, 1872.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere for 1872, 1873, Nordsee, 290, 1865 (*Liljeborgi*).

Plate X, figure 3.

Massachusetts Bay!: about six miles south to southeast from Gloucester, 40 to 45 fathoms, soft brown mud, 1878; about twelve miles east-southeast one-half south from Salem, 48 fathoms, soft brown mud, 1877,—common. Gulf of Maine!: about seven miles southeast by east one-half east from Cape Ann, 73 to 75 fathoms, soft mud, 1878; fourteen miles southeast from Cape Ann, 90 fathoms, soft mud, 1877,—common; about thirty miles east-southeast from Cape Ann, 85 fathoms, mud, sand and stones, 1878. Off Casco Bay!, twenty miles southeast of Cape Elizabeth, 68 fathoms, mud, 1873. Gulf of Maine!, seventeen miles south from Monhegan Island, 72 fathoms, brown mud, 1873; Cashe's Ledge, 27 and 40 fathoms, rocks and gravel, and west of the Ledge, 105 fathoms, mud and gravel, 1874. Latitude 42° 45' north, longitude 66° 28' west, about east-southeast from Cape Sable, Nova Scotia!, 75 fathoms, fine sand and mud, 1877. Le Have Bank!, 45 fathoms, gravel and stones, 1872. About thirty miles south of Halifax!, Nova Scotia, 101 fathoms, fine sand and mud, common, and also about one hundred and twenty miles south of Halifax, 190 fathoms, mud, 1877. West coast of Norway!, 60 to 100 fathoms (G. O. Sars). Scotland! (Norman). North Sea (Norman, Metzger).

The males, among the specimens examined, vary from 24 to 38<sup>mm</sup> in length, and the females from 26 to 58<sup>mm</sup>. All the American specimens were taken in August and September, and none of the females were carrying eggs.

I have seen neither Norman's nor Danielssen's original description of this species and have identified it by comparison with English specimens received from the Rev. Mr. Norman and Norwegian specimens received from Prof. G. O. Sars. The species agrees well too with *H. Liljeborgii* Danielssen as described and figured by Danielssen and Boeck (loc. cit.). These authors state that *H. Liljeborgii* was briefly described by Danielssen in *Nyt Magazin for Naturvidenskaberne*, 1861, p. 6, thus antedating Norman's species, which they quote as a synonym. Goës, however (*Øfversigt af Kongl. Vetenskaps-Akad. Förhandlingar*, 1863, p. 170 (10)), quotes "*H. Liljeborgi* Danielsen, *Fanna litor. Norveg. nondum edita*," and neither he, nor

G. O. Sars, nor Metzger refer to this early description, so that I allow the species to stand for the present under Norman's name.

**Hippolyte macilenta** Kröyer.

Bedford Basin!, Halifax, Nova Scotia, 26 to 41 fathoms, soft mud, common, 1877. Also off Halifax!, 42 fathoms, fine sand; 52 fathoms, fine sand and mud; and 57 fathoms, mud and pebbles. Gulf of St. Lawrence!, 30 to 70 fathoms, sandy and stony bottoms, 1872, 1873 (Whiteaves). Labrador! (Paekard). Greenland (Kröyer).

This species was described by Kröyer from a single specimen and I have noticed no mention of other specimens, except those of Paekard and Whiteaves above referred to. The species is very distinct from the others of the genus known to me. Kröyer's description and figures apply well to medium sized females, but there is some individual variation and the young differ very considerably from the adults in the form of the rostrum. It is the most slender of our species, the carapax being scarcely thicker posteriorly than in front, and its greatest breadth only about an eighth of the length of the animal. The appendages are likewise longer and more slender than usual in the genus. In adults of both sexes the dorsum of the carapax is evenly rounded the posterior two-thirds of its length and the rostral earina rises abruptly from the anterior fourth. The rostrum is very much shorter than the rest of the carapax, scarcely reaches the tips of the peduncles of the antennulæ, is very much compressed, and ascends so that the tip is considerably above the level of the dorsum of the carapax, while the dorsal edge is strongly arcuate and dentate, very nearly its entire length, with twelve to fifteen minute teeth, which are crowded anteriorly but much more remote at the base and on the carapax. The anterior portion of the rostrum is expanded below and armed with one to four small teeth near the very slightly prominent tip. In the young the rostrum is slender, nearly horizontal, only slightly expanded vertically, terminates in an acute tip and is armed with fewer teeth than in the adult, although there are at least nine above and one below in all the specimens I have seen. There are no supraorbital spines, but well-developed antennal and distinct pterygostomial spines are present in all the specimens. The flagellum of the antenna, at least in adult males, is considerably longer than the body; two males, 41 and 43<sup>mm</sup> long, each have the flagella about 50<sup>mm</sup> long. The telson is much more slender than usual in the genus. In twenty specimens specially examined, there were invariably three pairs of dorsal aculei, and in fourteen speci-

mens the terminal spines were invariably (as doubtfully described by Krøyer) six in number, the median pair slender and ciliated, the submedian very long and slender, and the outer short, as usual.

None of the females examined are carrying eggs. The males are scarcely perceptibly more slender than the females. The sexual characters are well-marked, in the antennulæ and abdominal appendages, in specimens 30<sup>mm</sup> long, although in specimens 26<sup>mm</sup> long the secondary appendage peculiar to the male is only just making its appearance on the inner lamella of the second pair of abdominal appendages.

Locality.	Sex.	Length.	Carapax and rostrum.	Rostrum, length.	Breadth of carapax.	Rostrum, formula.
Labrador,	♀	53·mm	17·5mm	6·1mm	6·1mm	$\frac{2+13}{2}$
Gulf St. Lawrence,	"	51·	16·0	6·0	6·0	$\frac{2+12+4}{4}$
"	"	47·	14·1	5·0	5·8	$\frac{2+12}{2}$
"	"	41·	13·0	5·1	5·0	$\frac{2+11}{1}$
Bedford Basin,	"	45·	14·7	6·0	5·8	$\frac{2+12}{1}$
"	"	44·	14·4	5·9	5·2	$\frac{2+13}{2}$
"	"	43·	13·8	5·4	5·1	$\frac{2+12}{4}$
"	"	42·	13·3	5·3	5·2	$\frac{2+13}{1}$
"	"	41·	13·0	5·1	4·9	$\frac{2+12}{2}$
Gulf St. Lawrence,	♂	43·	12·3	4·2		$\frac{2+10}{1}$
"	"	39·	12·2	4·3		$\frac{3+11}{3}$
Bedford Basin,	"	42·	12·6	4·9	5·1	$\frac{3+12}{2}$
"	"	41·	12·3	4·7	5·1	$\frac{3+13}{3}$
"	"	37·	11·3	4·4	4·8	$\frac{3+12}{2}$
Off Halifax,	"	29·	9·0	3·3	4·7	$\frac{2+9}{1}$
"	"	27·	8·7	3·2	3·8	$\frac{2+9}{2}$
"	"	26·	8·0	2·9	3·7	$\frac{2+8}{1}$
"	"	24·	7·1	2·4	3·6	$\frac{2+7}{1}$
Gulf St. Lawrence,	"	23·	7·2	2·5	3·4	$\frac{2+7}{1}$
"	"	22·				$\frac{2+7}{1}$
"	"	21·				$\frac{2+7}{1}$

The preceding table gives measurements\* and the dental formula for the rostrum of some of the specimens from different localities.

### Hippolyte Phippsii Kröyer.

*Hippolyte Phippsii* Kröyer, Naturhistorisk Tidsskrift, iii, p. 575, 1841 (♂).

*Hippolyte turgida* Kröyer, loc. cit., p. 575, 1841 (♀).

*Hippolyte vibrans* Stimpson, Annals Lyceum Nat. Hist. New York, x, p. 125, 1871 (♂, var.)

? *Hippolyte Ochotensis* Brandt, in Middendorff's Sibirische Reise, ii, p. 120, pl. 5, fig. 17, 1849 (♀).

Massachusetts Bay!, off Salem, 1877: 20 fathoms, rocks and gravel; 33 fathoms, sand and mud; 35 fathoms, mud and clay nodules; and 48 fathoms, soft mud. Off Cape Ann!, 50 fathoms, mud and gravel, 1877. Off the Isles of Shoals!, 27 to 36 fathoms, rocks and mud, 1874. Jeffrey's Ledge!, 24 fathoms, gravel and stones, 1873. Cashe's Ledge!, 27 and 40 fathoms, 1874,—27 males and 24 females. Near Cashe's Ledge!, 52 to 90 fathoms, rocky, 1873. Casco Bay!, 10 to 22 fathoms, rocky, near West Cod Ledge, 1873. Eastport!, Bay of Fundy, 18–25 fathoms, rocks and shells, 1868, 1870. Grand Menan!, Bay of Fundy, 1872 (Prof. H. E. Webster). Halifax!, Nova Scotia, 1877: 16 fathoms, fine sand and red algæ; 18 fathoms, fine sand; 25 fathoms, rocks and nullipora; 25 fathoms, gravel; and 26 to 41 fathoms, soft mud, in Bedford Basin,—a single specimen. Gulf of St. Lawrence! (J. F. Whiteaves): off Trinity Bay, 90 fathoms, small stones and coarse sand, and off Cape Rosier Light, 125 fathoms, mud, 1871; Orphan Bank, 1873. Labrador! (A. S. Packard, Jr.) Grinnell Land and as far north as latitude 81° 44' (Miers). Greenland (Kröyer, Stimpson, et al.). Arctic

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\* In these measurements, as in all those which I give of *Maerura* and *Sehizopoda*, the length is from the tip of the rostrum to the tip of the telson while the abdomen is extended nearly straight with the carapax; the length of the carapax and rostrum is from the tip of the rostrum to the middle of the posterior margin; the length of the rostrum is from the tip to the posterior margin of the orbit; the breadth of the carapax is at the widest point—a measurement which varies with the state of contraction more than the others. The length of the rostrum as measured above may be very slightly too great, particularly if the rostrum be relatively short, since it is not perfectly parallel with the longitudinal axis, but it has the practical advantage of being between definite points—a matter of the utmost importance. The length of the carapax exclusive of the rostrum is taken from the posterior margin of the orbit to the middle of the posterior margin, but is found accurately enough by subtracting the length of the rostrum from that of the carapax and rostrum. If the rostrum is very short it is better to measure the length of the carapax exclusive of the rostrum and find the length of the rostrum by subtraction.

Ocean and Bering Straits (Stimpson). ? Sea of Ochotsk (Brandt) and the island of Jesso (Stimpson)—*H. Ochotensis*. Spitzbergen (Kröyer). Coast of Norway! (G. O. Sars).

The examination of a large series of specimens shows conclusively that Kröyer's *H. turgida* is only the full-grown female of his *Phippisii*, as suggested by Goës, and that Stimpson's *vibrans* is a mere variety without any real claim to specific rank. Kröyer included young females under his *Phippisii*, as he distinctly states he had both sexes of that species, and it is not strictly true, as Goës implies, that all the males fall under one of Kröyer's species and all the females under the other, for the young males and young females are almost indistinguishable, except by the essential sexual characters, and agree with Kröyer's description of *Phippisii*. As in many similar cases of great differences in the sexes, the relation of the two forms may be easily established, with sufficient specimens, by tracing the forms back in two series toward the young, where the secondary sexual characters disappear and the two forms are seen to be specifically identical. In the present case the smallest females in which the sex is easily distinguishable differ scarcely at all in the form of the rostrum and in the other characters which Kröyer gives as characteristic of the two species.

I have never seen males which could be regarded as agreeing well with the characters of *turgida* as given by Kröyer, and I cannot explain the statement of Buchholz (who retains both Kröyer's species though regarding them as probably varieties of one species) that he had, from East Greenland, two males of *H. turgida*, 30 to 35<sup>mm</sup> in length, without supposing some mistake in the determination of the sex of the specimens,—a supposition which I have no sufficient reason for hazarding.

The only characters which Stimpson gives for distinguishing his *H. vibrans*, found in Massachusetts Bay, from the *Phippisii* of Kröyer are that it has "but one spine over the eye," and that there are "only two or three teeth beneath the tip of the rostrum." The lower of the two supraorbital spines each side is really very small when best developed; it is not at all constant, there being a complete gradation between specimens in which it is well-developed and those in which it is entirely absent; and it often varies considerably on the two sides of the same individual. The number of teeth on the inferior edge of the rostrum is of even less importance as a distinguishing character, for three or four is the usual number in the typical *Phippisii* and specimens with only two beneath the rostrum

often have both pairs of supraorbital spines well-developed, so that the two characters do not even accompany each other. This variety is evidently the form of which Miers (Annals and Magazine Nat. Hist., iv, xx, p. 62 (12), 1877) had a single specimen from Cape Frazer, Grinnell Land, and to which he refers under *H. Phippsii*?

The following table exhibits these variations in a series of specimens selected from a much larger number. In the last column I have attempted to indicate the variation in the supraorbital spines, although it is impossible to express in words the completeness of the gradation between those individuals in which the lower spine is fully developed and those in which it is entirely wanting.

Locality.	Sex.	Length.	Rostrum.	Supraorbital spines each side.
Grand Menan,	♂	24.5mm	$\frac{3+6}{4}$	Two well-developed.
"	"	24.3	$\frac{4+5}{3}$	" "
"	"	25.0	$\frac{4+6}{2}$	Two, one very minute.
"	"	25.5	$\frac{4+5}{3}$	One only.
"	"	25.2	$\frac{4+5}{2}$	One, with rudiment of 2d.
"	"	24.3	$\frac{4+6}{4}$	One only.
"	"	21.8	$\frac{3+7}{3}$	" "
Cashe's Ledge,	"	19.2	$\frac{2+6}{2}$	Two well-developed.
"	"	17.0	$\frac{0+6}{2}$	Two, one very small.
"	"	15.5	$\frac{3+5}{2}$	" " "
"	"	18.5	$\frac{3+6}{2}$	Two, one scarcely percepti- [ble.
"	"	17.5	$\frac{3+5}{4}$	One only.
"	"	17.1	$\frac{4+6}{4}$	" "
"	"	17.0	$\frac{3+6}{3}$	Two.
"	"	16.0	$\frac{4+6}{2}$	One.
"	"	16.5	$\frac{3+7}{3}$	"
Isles of Shoals,	"	16.7	$\frac{3+6}{4}$	Two, one scarcely percepti- [ble.
Cashe's Ledge,	"	16.5	$\frac{3+7}{3}$	One.
"	"	15.5	$\frac{3+5}{2}$	Two well-developed.

Locality.	Sex.	Length.	Rostrum.	Supraorbital spines each side.
Cashe's Ledge,	♂	15.0 <sup>mm</sup>	$\frac{3+7}{3}$	Two.
"	"	14.3	$\frac{3+5}{2}$	Two, one very small.
Halifax,		12.0	$\frac{2+3}{1}$	One only!
"	♀	17.5	$\frac{4+7}{3}$	Two, one very small.
Mass. Bay,	"	18.0	$\frac{3+6}{4}$	Two, one scarcely percepti- [ble.
Cashe's Ledge.	"	19.0	$\frac{4+5}{4}$	One only!
"	"	21.8	$\frac{3+6}{4}$	Two well-developed.
"	"	21.3	$\frac{4+7}{6}$	" "
"	"	24.0	$\frac{4+4}{5}$	" "
Norway,	"	22.6	$\frac{4+6}{7}$	" "
Casco Bay,	"	29.0	$\frac{3+5}{6}$	" "
Grand Menan,	"	32.6	$\frac{4+6}{5}$	" "
"	"	35.5	$\frac{4+6}{5}$	" "
"	"	37.0	$\frac{4+6}{4}$	" "

The form of the telson and the number of its dorsal aculi and terminal spines was usually very constant in all the specimens examined. In thirty-five out of forty-four individuals there were four pairs of aculi, or four upon one side and five upon the other: of the remainder, six (two males, 21 and 26<sup>mm</sup> long, and four females, 19 to 36.5<sup>mm</sup> long) had five pairs; a male of 25<sup>mm</sup>, five upon one side and six upon the other; a female of 37<sup>mm</sup>, four upon one side and three upon the other; and a female of 25.5<sup>mm</sup>, only three pairs. In thirty-seven specimens in which the spines of the tip were specially examined, only one (a female 36<sup>mm</sup> long, from Halifax, Nova Scotia, and in all other respects perfectly normal) varied from the normal number, this specimen having three small ciliated spines in the middle in place of the two in normal specimens. This is a case precisely similar to that noticed under *H. Gaimardii*, and figured on Plate IX, figure 9, except that in this case there seems to be no variation whatever in the form of the terminal margin itself.

In life the males at least are semi-translucent, and specked and irregularly mottled with obscure brownish red on the carapax and appendages.

*Hippolyte pusiola* Kröyer.

Plate IX, figures 4, 5, 6, 7.

Off Block Island!, 8 to 10 fathoms, rocky, 1874. Off Stonington!, Connecticut, 4 to 5 fathoms, rocky, 1873 (A. E. Verrill and D. C. Eaton). Vineyard Sound!, 2 to 12 fathoms, gravelly and shelly, not common, 1871 and 1875. Off Nantucket!, 15 fathoms, 1875. Massachusetts Bay!, off Salem, 1877, 20 fathoms, rocks and gravel; 35 fathoms, mud and clay nodules; 48 fathoms, soft mud,—one specimen. Off Cape Ann!, 50 fathoms, mud, gravel and rocks, 1877. Also, Salem Harbor!, 4 fathoms (J. H. Emerton). Casco Bay!, 1873, at low-water mark!, among stones, on Ram Island Ledge; also at numerous localities in from 4 to 33 fathoms, rocky and gravelly, or "hard" bottoms, and abundantly in the stomachs of the cod taken on West Cod Ledge!. Jeffrey's Ledge!, 24 fathoms, gravel and stones, 1873. Cashe's Ledge!, 27 and 39 fathoms, rocks and gravel, 1874,—abundant; abundant also near the Ledge!, in 52 to 90 fathoms, 1873. George's Bank!, 45 fathoms, coarse sand, 1872,—one specimen. Bay of Fundy!, 1864, 1868, 1870, 1872, 1876: not uncommon at low-water mark!, among stones and algæ; common in 5 to 50 fathoms, rocky, gravelly and shelly bottoms; off White Head, Grand Menan, 97 to 105 fathoms, gravelly, 1872. Le Have Bank!, 45 fathoms, gravel and stones, 1872,—abundant. Halifax, Nova Scotia!, 1877: 16 fathoms, rocky; 18 fathoms, fine sand; 25 fathoms, gravel; and one specimen also from 16 fathoms, mud. Gulf of St. Lawrence!, Orphan Bank and, in 10 fathoms, gravel, stones and broken shells, off Sea-Cow Head, Prince Edward Island, 1873 (J. F. Whiteaves). Iceland (G. O. Sars). Lofoten Islands!, coast of Norway (G. O. Sars). Scotland! (Norman). North Sea (Norman, Metzger).

I have not been able to discover any authentic record of the occurrence of this species in Greenland. The statement, by Prof. Verrill and myself, in the Report on the Invertebrate Animals of Vineyard Sound, pp. 396 (102) and 550 (256), that it extends to Greenland, was made without any authority, and the including of Greenland in its geographical range by Kingsley (Bulletin Essex Institute, vol. x, p. 59), is probably due to our error, although Mr. Kingsley gives no authority for his statement. The species has, however, an extensive northern range, and will very likely yet be found in Greenland.

Out of one hundred and six specimens in which the rostrum was specially examined, ninety-two (among which the males varied from

10.5 to 17<sup>mm</sup> in length, and the females from 13 to 23<sup>mm</sup>) had either three or four teeth on the dorsal edge of the rostrum, and none at the tip or beneath; and this is evidently the normal rostral dentition of the species, although the fourteen remaining specimens show considerable deviation from this typical form. Of these fourteen specimens, nine) all females from off Nantucket, from the Bay of Fundy, and from Halifax, Nova Scotia, and varying from 19 to 25<sup>mm</sup> in length), have four teeth above and one beneath the tip, and three of these nine, all females from the Bay of Fundy, and each about 23<sup>mm</sup> in length, have the inferior tooth so near the tip that the tip is best described as bifid; one female, 22<sup>mm</sup> long, from the Bay of Fundy, is similarly armed at the tip but has only three teeth above; one female, 16<sup>mm</sup> long, from Halifax, Nova Scotia, has five distinct teeth above but none below; while three males, 12 to 13.5<sup>mm</sup> long, from Casco Bay and Cashe's Ledge, have only two teeth above. This would seem to show that a tendency to an increase in the number of rostral teeth is characteristic of the females, while the reverse is the case in respect to the males.

The usually very constant arrangement of the terminal spines of the telson is occasionally subject to variation, which apparently follows the same tendency in the sexes as the variation in the number of rostral teeth, although the number of observations in either case is too small for a reliable generalization. Of forty-eight specimens in which the tip of the telson was specially examined, forty-five (among which the males varied from 12 to 17<sup>mm</sup> in length, and the females from 14 to 25<sup>mm</sup>), had the normal number of terminal spines; that is, a short one at the lateral angle each side, two much longer ciliated ones in the middle, and, between these and the lateral spines each side, a still longer and stouter spine, making six in all (Plate IX, figure 7). Of the remaining specimens, a male 17<sup>mm</sup> long, from the Bay of Fundy, has but one median ciliated spine, so that there are only five in all (Plate IX, figure 6); and yet there is not the slightest appearance of this irregularity being due to injury, and the specimen is in all other respects perfectly normal. A female 20.5<sup>mm</sup> long, from the Bay of Fundy, has nine spines, of which the three median are ciliated (Plate IX, figure 4); there is a little irregularity in the spines, apparently due to some slight injury. Another female 16<sup>mm</sup> long, from Halifax, Nova Scotia, has also nine spines, of which the five central ones were probably ciliated, although, apparently on account of the imperfect state of preservation of the specimen, I was able to discover cilia on only a part of them, as shown in the figure

(Plate IX, figure 5). In this last specimen there is evidence of injury in the irregular outline of one of the lateral angles of the tip of the telson, in the irregularity of the spines, and particularly in the supplemental group of three aculei near this irregular angle as shown in the figure.

The largest specimens examined are from the Bay of Fundy, the largest male being 17<sup>mm</sup> in length, and the largest female 25<sup>mm</sup>.

The color in life varies considerably, as the following notes, unfortunately all made upon adult females, show. A specimen, taken among stones and algæ at low-water mark at Eastport, Maine, was translucent specked upon the body and appendages with bright red, and with a white dorsal line extending from the tip of the rostrum to the telson. Another, dredged at Eastport, in 20 to 25 fathoms, rocky and shelly bottom, was faintly specked with pale red on the carapax and the sides of the abdomen; the antennæ, antennulæ and cephalothoracic legs annulated and the abdominal legs, telson and the uropodal lamellæ banded with the same color. Still another specimen, from 40 to 50 fathoms, rocky bottom, at Eastport, was much more brilliantly colored, though after the same pattern: the eye-peduncles and the bases of the antennulæ, antennæ and cephalothoracic legs were thickly specked with bright red, the distal portions of the legs and the flagella of the antennulæ and antennæ were closely annulated, while the antennal scales, carapax and abdomen were transversely banded with the same color; the band upon the sixth segment of the abdomen and that across the telson and uropodal lamellæ were nearly as broad as the length of the sixth segment and the telson respectively, and very deep bright red. A considerable number of specimens taken among stones and red algæ upon the Cod Ledges, Casco Bay, were very brightly colored, much in the same way as the last specimen. According to notes made by Professor Verrill in 1870, two specimens dredged in 15 fathoms, stony bottom, north of Treat's Island, Eastport Harbor, differed considerably in color; one was pale flesh-color with a median dorsal stripe of whitish and the sides speckled with pale red, the flagella of the antennulæ and antennæ having alternate bands of pale reddish and flesh-color, and the legs thickly speckled with light brownish and obscurely banded with the same; while the other specimen was pale grayish, with about five transverse whitish bands on the abdomen, and a dark gray band across the sixth segment and another across the telson and uropodal lamellæ, and with the cephalothoracic legs banded with white and gray.

Females carrying eggs are abundant in all the collections I have

examined; these collections have been made in July, August, September, October and April, so that the species evidently breeds during a large portion of the year.

### *Hippolyte polaris* Ross.

*Alpheus polaris* Sabine, in Supplement to appendix of Parry's [first] Voyage, p. ccxxxviii, pl. 2, figs. 5-8, 1824.

*Hippolyte polaris* J. C. Ross, in John Ross, Appendix to narrative of a second Voyage in search of the northwest passage, p. lxxxv, 1835 (♀).

*Hippolyte borealis* J. C. Ross, in John Ross, op. cit., p. lxxxiv, pl. B, fig. 3, 1835 (♂).

? *Hippolyte cuttellata* Norman, in Report of exploring the Hebrides, part ii, Report British Assoc. Adv. Sci., 1866, p. 200, 1867; Last Report on dredging among the Shetland Isles, op. ult. cit., 1867, p. 265.

#### Plate XI, figures 1 to 4.

Massachusetts Bay!, off Salem, 1877: 35 fathoms, mud and clay nodules; and 48 fathoms, soft mud [*a*]. Between Cape Ann and the Isles of Shoals!, 33 fathoms, gravel and stones, 1873 [*b*]. Casco Bay!, 1873 [*c*]: near West Cod Ledge, 10 to 15 fathoms, rocky, and from stomachs of the cod taken at the same locality. Also off Seguin Island!, 48 fathoms, gravel, 1873 [*d*]. Cashe's Ledge!, 30 to 40 fathoms, gravel [*e*]; and near the Ledge, 65 fathoms, mud and gravel, 1874 [*f*]. Bay of Fundy!, 1870, 1872 [*g*]. About east-southeast from Cape Sable, Nova Scotia!, north latitude 42° 45', west longitude 66° 27', 75 fathoms, fine sand and mud, 1877 [*h*]. Off Cape Negro!, Nova Scotia, 59 fathoms, pebbles, sand and rocks, 1877. Halifax!, Nova Scotia, 1877: 16 fathoms, rocks, and stones and red algæ [*i*]; 18 fathoms, fine sand [*k*]; and 25 fathoms, gravel. Off Halifax!, 1877: 25 fathoms, rocks and nullipora [*l*]; 52 fathoms, fine sand and mud; and 100 fathoms, fine sand [*m*]. Gulf St. Lawrence! (Whiteaves, 1871). Labrador! (Packard). Grimmell Land (Miers). Greenland (Kröyer, et al.), as far north as 81° 44' (Miers). Arctic Ocean, north of Bering Straits (Stimpson). Spitzbergen (Kröyer, Miers). West coast of Norway! (G. O. Sars) [*n*]. North Sea (Metzger). ? Shetland Islands (*H. cuttellata* Norman).

This species presents another case of differences between certain individuals among the adult males, or perhaps more properly old males, on the one hand, and the females and younger males, on the other hand; that is, the *borealis*-form bears much the same relation to the original *polaris* as *gibba* does to *Gaimardii*, and a relation somewhat similar to that of *Phippisii* to *turgida*. The specimens before me show a very complete series connecting the most characteristic form of *borealis* with the ordinary forms of *polaris*. Of the spe-

cimens examined, all the males 28<sup>mm</sup> or less in length have well-developed rostral teeth and a distinct spine (the pterygostomian) at the inferior angle of the anterior margin of the carapax, and in these characters agree fully with the female. In all the specimens much above 30<sup>mm</sup> in length the pterygostomian spines are small, rudimentary or wanting, though they do not seem to disappear wholly at any particular size of the individual. The disappearance of the dorsal teeth of the rostrum is still more irregular and is evidently a character peculiar to, but not characteristic of, the adult male. There are often very rudimentary teeth present which could not be discovered without the aid of a lense, and the gradation between the forms in which they are well-developed and those in which they are wholly wanting is most complete. That the form of male with edentulous rostrum and without pterygostomian spines has no claim to be retained as a species is conclusively shown, (1) by the complete gradation in these characters between this form and the original *polaris*-form, (2) by the fact that one of the characters may exist without the other in the same individual, and (3) by the negative evidence that there is no corresponding female form.

The following tabulation of the character of the rostral teeth and the pterygostomian spines, together with the length of the individual and the rostral formula, in a series of specimens selected from a much greater number, exhibits some of the variations. The letters indicating the localities correspond with those in brackets under the distribution of the species given above.

Locality.	Sex.	Length.	Rostral Formula.	Dorsal teeth of rostrum.	Pterygostomian spine.
<i>k</i> <sub>1</sub>		23.7mm	$\frac{2+3}{2}$	Well-developed.	Well-developed.
<i>k</i> <sub>2</sub>		24.0	$\frac{2+2}{2}$	"	"
<i>k</i> <sub>3</sub>	<i>r</i>	25.0	$\frac{2+3}{3}$	"	"
<i>l</i>	"	25.7	$\frac{2+3}{2}$	"	"
<i>i</i> <sub>1</sub>	"	26.0	$\frac{2+5}{3}$	"	"
<i>c</i> <sub>1</sub>	"	26.5	$\frac{2+4}{2}$	"	"
<i>j</i> <sub>1</sub>	"	27.0	$\frac{2+5}{4}$	"	"
<i>b</i> <sub>1</sub>	"	28.0	$\frac{2+2}{2}$	"	"
<i>k</i> <sub>4</sub>	"	30.0	$\frac{2+3}{3}$	"	"
<i>c</i> <sub>2</sub>	"	32.0	$\frac{2+2}{3}$	"	Small.

Locality.	Sex.	Length.	Rostral Formula.	Dorsal teeth of rostrum.	Pterygostomial spine.
k,	♂	34.0mm	$\frac{2+3}{4}$	Well-developed.	Rudimentary.
g,	"	35.4	$\frac{2+4}{3}$	"	Very small.
f,	"	39.5	$\frac{3+5}{4}$	"	Scarcely perceptible.
g,	"	43.0	$\frac{2+3}{2}$	Very small.	Rudimentary.
b,	"	32.0	$\frac{? ?}{3}$	Scarcely perceptible.	Small.
b,	"	33.0	$\frac{? ?}{3}$	Very minute.	Absent?
m,	"	34.0	$\frac{2+3}{4}$	Very small.	Wholly absent.
n,	"	36.0	$\frac{2?+3?}{4}$	Very minute.	Wholly absent.
h,	"	37.0	$\frac{? ?}{2?}$	Scarcely perceptible.	Wholly absent.
e,	"	30.0	$\frac{0+0}{3}$	Absent.	Very rudimentary.
e,	"	31.0	$\frac{0+0}{3}$	"	Very rudimentary.
e,	"	32.0	$\frac{0+0}{0?}$	"	Wholly absent.
k,	♀	29.4	$\frac{2+3}{3}$	Well-developed.	Well-developed.
k,	"	31.0	$\frac{3+3}{3}$	"	"
e,	"	33.0	$\frac{2+3}{3}$	"	"
e,	"	33.5	$\frac{2+2}{2}$	"	"
g,	"	35.0	$\frac{2+4}{4}$	"	"
c,	"	40.0	$\frac{2+3}{2}$	"	"
i,	"	41.0	$\frac{2+3}{3}$	"	"
n,	"	42.4	$\frac{2+2}{4}$	"	"
u,	"	45.0	$\frac{2+5}{3}$	"	"
n,	"	48.0	$\frac{3+4}{3}$	"	"
n,	"	49.0	$\frac{2+4}{5}$	"	"
l,	"	55.0	$\frac{2+3}{3}$	"	"
d,	"	55.0	$\frac{2+3}{2}$	"	"
g,	"	56.0	$\frac{2+4}{3}$	"	"
a,	"	56.0	$\frac{2+3}{3}$	"	"

The number of dorsal aculei upon the telson varies from four to ten pairs. The greatest number noticed being in the case of two females 48 and 49<sup>mm</sup> in length, from the coast of Norway; the smallest number, in males 27 to 35<sup>mm</sup> long and females 31 to 34<sup>mm</sup>, from our own coast. That the number has no very close relation to the size of the individual is shown by a male 34<sup>mm</sup> long having six aculei on one side and eight upon the other; while the largest specimen examined, a female 56<sup>mm</sup> long, from the Bay of Fundy, has four upon one side and five upon the other. In thirty specimens from New England, Nova Scotia and the coast of Norway, the terminal spines of the telson are as described by Kröyer, that is four median ciliated ones and two stouter each side, making eight in all. A single female specimen, 31<sup>mm</sup> long, from Labrador, differs however in having five median ciliated spines with two stouter spines each side, making nine in all,—a case precisely similar to that mentioned under *H. Gaimardii*.

The following notes on the color while living were made by Professor Verrill on an adult female, from 12 fathoms, Johnson's Bay, Bay of Fundy, 1870. Body pale flesh-color, beautifully spotted and barred transversely with orange-brown, the abdomen with somewhat rounded, unequal spots which tend to form transverse bars above, but on the second, third and fourth segments there is a regular band of this color. The carapax is spotted on the sides with orange-red and sparingly with sulphur-yellow; the upper portion bluish green, finely specked with brown and yellow, and with three lateral spots on each side and two median of bright blue. Between the eyes and passing obliquely backward is a stripe of red. On the sides of the abdomen are five specks of sulphur-yellow and above these are two small bright blue spots on the fifth segment and a median one with two smaller each side on the second. The telson and uropodal lamellæ are brownish at base, behind which there is a sulphur-yellow band bordered with white, the rest of the lamellæ speckled with brown, and the outer ones with a semi-circular spot of dark purplish brown near the middle of the outer margin. The flagella of the antennæ are salmon-color banded with orange-red. The first pair of cephalothoracic legs are red at base and on the terminal segments; the second are banded with red near the base and at the tip; the third and fourth are red at base, then banded with yellow, whitish and dark brown alternately, and the terminal segments flesh-color; the posterior pair are similar but have a sulphur-yellow base. The abdominal legs are flesh-color, spotted and transversely banded with dark red and sulphur-yellow.

Males when not more than 25<sup>mm</sup> in length show distinctly the sexual characters in the first and second pairs of abdominal legs, and they arrive at sexual maturity at a little over 30<sup>mm</sup> in length, if not earlier, since two specimens which I have examined, 34 and 37<sup>mm</sup> long, have the sperm ducts, or spermatophores extruded,—probably a result of the contraction due to the preservation of the specimens in alcohol. Among four females carrying eggs the smallest is about 40<sup>mm</sup> in length. These four, the only specimens seen with eggs, were all taken in 16 to 100 fathoms, at and off Halifax, Nova Scotia, September 4, 5, 6, 1877.

Since some, even recent, authors have apparently had difficulty in distinguishing with certainty the sexes in the species of *Hippolyte*, I introduce figures of the first pair of abdominal appendages and of the inner lamella of the second pair in the male and female of this species, to illustrate the sexual differences in these appendages in the genus. (Plate XI; figure 1, appendage of the left side of the first segment of the male; figure 3, corresponding appendage of the female; figure 2, inner lamella of the appendage of the left side of the second segment of the male; figure 4, corresponding part of the appendage of the female). At least in all the species of *Hippolyte* mentioned in this paper, the differences in these appendages in the two sexes are very similar to those shown in these figures, and are so conspicuous that they afford the readiest means for distinguishing the sexes, which is easily done at a glance.

In the first pair of abdominal appendages of the female, both lamellæ are furnished with long plumose setæ upon each margin to the very tip, as in the succeeding appendages; the outer lamella is always much narrower than the more or less ovate inner one and is linear in outline. In the male the basal portion of the appendage is relatively smaller than in the female; the outer lamella is similar to that in the female, but very much larger, and even larger than the inner lamella in the male; this inner lamella always tapers rapidly into a slender terminal portion which is naked, except a few minute, very short, modified and hook-like spines at the very tip; the margins toward the base, however, are furnished with short setæ or slender spinules, but entirely want the long plumose setæ so characteristic of the corresponding parts of the other appendages.

In the second pair of abdominal appendages, the differences are mostly confined to the inner lamellæ, which are narrowly ovate, and margined with long, plumose setæ in both sexes, but in the female there is, arising from the proximal half of the inner margin,

a single, slender process which is entirely naked except at the tip, where it is armed with numerous modified spines like those upon the tip of the inner lamella of the first pair of appendages in the male; while in the male there is a similar process, usually arising nearer the base, however, but always accompanied by a somewhat smaller process arising just at the base of the first and furnished with numerous long setæ like the marginal setæ of the lamella itself.

### *Hippolyte Grœnlandica* Miers.

*Astacus Grœnlandicus* J. C. Fabricius, *Systema Entomologiæ*, p. 416, 1775; *Entomologia systematica*, ii, p. 484, 1793.

*Cancer aculeatus* O. Fabricius, *Fauna Grœlandica*, p. 239, 1780.

*Alpheus aculeatus* Sabine, in *Supplement to appendix of Parry's [first] Voyage*, p. cxxxviii, pl. 2, figs. 5-8, 1824.

*Hippolyte aculeata* J. C. Ross, in *John Ross, Appendix to narrative of a second Voyage in search of the northwest passage*, p. lxxxiii, 1835.

*Hippolyte armata* Owen, *Voyage of the Blossom*, p. 88, pl. 27, fig. 2, 1839 (♀).

*Hippolyte cornuta* Owen, *op. cit.*, p. 89, pl. 28, fig. 2, 1839 (♂).

*Hippolyte Grœnlandica* Miers, *Annals and Magazine Nat. Hist.*, IV, xx, p. 62 (12), 1877.

Salem Harbor!, Massachusetts, 6 fathoms, 1873; also off Baker's Island!, 20 fathoms (J. H. Emerton, 1878). Between Cape Ann and the Isles of Shoals!, 33 fathoms, gravel and stones, 1873. Casco Bay!, 1873: between Overset and Peak's Islands, 18 fathoms, rocks and sponges; West Cod Ledge, 10 to 20 fathoms, rocky; and from the stomachs of cod taken at the last locality. Grand Menan!, Bay of Fundy, 1872; also off Flagg's Cove!, Grand Menan, 15 fathoms, shells, mud and stones, 1873. Off Treat's Island!, Eastport, Maine, 15 fathoms, stones, 1870. Halifax!, Nova Scotia, 1877: 16 fathoms, stones, sand and red algæ; 18 fathoms, fine sand, also mud and fine sand; 21 fathoms, fine sand and red algæ; and 25 fathoms, gravel. Murry Bay!, Gulf of St. Lawrence (Principal J. W. Dawson). Labrador (Packard). Grinnell Land, as far north as 82° 30' (Miers). Greenland (J. C. Fabricius, O. Fabricius, Krøyer, et al.). Bering Sea and Arctic Ocean north of Bering Straits (Owen, Stimpson).

The largest specimens examined were from the Bay of Fundy, the largest male 41<sup>mm</sup>, the largest female 55<sup>mm</sup> in length.

According to the following notes, made by Professor Verrill in 1870, on two males from the Bay of Fundy, this species varies considerably in coloration. A male 41<sup>mm</sup> long, from 15 fathoms, stony, north of Treat's Island, Eastport Harbor, had the body very pale whitish gray with faint clouds of dark gray on the carapax and a large spot of the same color on each side of each of the first five seg-

ments of the abdomen, those on the first three segments connected by a transverse dorsal band of the same, which, however, was narrowly interrupted in the middle on the first two segments. Flagella of the antennæ and antennulæ annulated with wide alternate bands of light red and white. Teeth of the rostrum dark brownish. Cephalothoracic legs white, annulated with pale red or flesh-color. Caudal lamellæ mottled with gray.

In the other specimen, 37<sup>mm</sup> long, from 10 fathoms, shells, mud and stones, Flagg's Cove, Grand Menan, the carapax was flesh-color specked and mottled with light red, dorsal teeth and rostrum thickly specked with darker red, and the posterior border with two spots of the same color. The first three segments of the abdomen with broad interrupted transverse bands of light red; the posterior segments and caudal appendages mottled and specked with the same. Flagella of the antennulæ and antennæ, and the cephalothoracic legs as in the other specimen.

#### *Pandalus borealis* Kröyer.

Massachusetts Bay!, about twelve miles east-southeast from Salem, 45 to 50 fathoms, mud, 1877, and also in 1878,—very abundant. Gulf of Maine!, off Cape Ann, 40 to 98 fathoms, mud, 1877, 1878,—very abundant, particularly in a region about fourteen miles southeast from Cape Ann, in from 50 to about 100 fathoms. East of Jeffrey's Ledge!, 114 fathoms, soft mud, 1873. Gulf of Maine!, about forty miles east of Cape Ann, 160 fathoms, 1877. Off Casco Bay!, eighteen to twenty miles southeast from Cape Elizabeth, 48 to 68 fathoms, mud, 1873,—common. Twenty to thirty miles southeast to southeast one-half east from Cape Sable, Nova Scotia!, 59 to 88 fathoms, fine sand, pebbles and rocks, 1877,—two small specimens. About thirty miles south to south by west one-fourth west from Halifax!, Nova Scotia, 85 to 110 fathoms, fine sand and mud, 1877. Greenland (Kröyer). Bering Sea (Brandt), Norway! (G. O. Sars), and south to the Cattegat (Goës).

According to notes made by Professor Verrill in 1877, this species when living is "thickly sprinkled with small red stellate spots, which, from closer aggregation, make the tail deeper in color than the rest of the body. Flagella of the antennulæ annulated with very narrow white rings alternating with very broad red bands. Flagella of antennæ deep red. Spermaries purplish red, the outer membrane golden. Ovaries blue. Eggs ultramarine blue."

Females carrying eggs were taken in August and September, 1877 and 1878, in and off Massachusetts Bay and off Cape Ann.

**Pandalus Montagu** Leach.

*Pandalus Montagu* Leach, "Edinburg Encyclopedia, vii, p. 432" (teste White), 1813 or 1814; American Edition, vii, p. 271.—White. Catalogue of British Crustacea in British Museum, p. 41, 1850.

*Pandalus annulicornis* Leach, Malacostraca Podophthalmata Britannia, pl. 40. March, 1815; Transactions of the Linnean Society, London, xi, p. 346, 1815.

*Pandalus terigatus* Stimpson, Marine Invertebrata of Grand Manan, p. 58, 1853.

Vineyard Sound!, in deep water off Gay Head, 1871; also off Buzzard's Bay!, 25 fathoms, and off Newport!, Rhode Island, 29 fathoms, 1871. At these localities south of Cape Cod, the species was rare and all the specimens of small size. Massachusetts Bay!, off Salem, 22 to 48 fathoms, gravelly, sandy and muddy bottoms, 1877, common. Also 45 fathoms, soft mud, off Cape Ann!, 1878. Stellwagen's Bank!, 22 to 44 fathoms, rocky and sandy, 1873. Gulf of Maine!, off Cape Ann, 75 and 90 fathoms, mud, 1877,—common and very large, and associated with *P. borealis*. Common on St. George's Banks!, in 28 fathoms, coarse sand; 30 fathoms, soft sand; 50 and 60 fathoms, sand and shells; and 45 fathoms, coarse sand, 1872. Also east of St. George's Banks!, 430 fathoms, sand, gravel and stones, 1872,—several specimens, unquestionably of this species. Casco Bay!, common in 10 to 45 fathoms, rocky, shelly, gravelly, sandy, and muddy bottoms, and in abundance in the stomachs of the cod taken on the Cod Ledges, 1873. Also off Casco Bay!, eighteen to twenty miles southeast of Cape Elizabeth, 48 to 68 fathoms, mud, 1878,—large individuals associated with *P. borealis*. Bay of Fundy!, 10 to 77 fathoms, 1864, 1868, 1870, 1872, 1876,—very common. About east-southeast from Cape Sable!, Nova Scotia, north latitude 42° 45', west longitude 66° 27', 75 fathoms, fine sand and mud, 1877. Halifax!, Nova Scotia, 16 to 25 fathoms, on bottoms of stones and red algae, gravel, and fine sand and stones, 1877. In Bedford Basin!, Halifax, 26 to 41 fathoms, soft mud, 1877,—two specimens. About ten miles off Halifax, 53 fathoms, sand, mud and rocks, 1877. Gulf of St. Lawrence! (Whiteaves). Labrador! (Packard). Greenland (Krøyer et al.). Iceland (G. O. Sars). Scandinavian coast! (G. O. Sars) and British Isles! (Norman et al.).

The largest specimens examined are from 90 fathoms, off Cape Ann, and are 115<sup>mm</sup> long. There are specimens over 100<sup>mm</sup> long from

other localities in the Gulf of Maine, from off Casco Bay, 48 to 68 fathoms, and from deep water in the Bay of Fundy.

In examining many hundreds of specimens only seven were found carrying eggs; these specimens vary between 75 and 100<sup>mm</sup> in length: one of them is from 48 fathoms, Massachusetts Bay, August 13, 1877; another is from 45 fathoms, in the same region, August 29, 1878; three are from 75 fathoms, Gulf of Maine, off Cape Ann, October 17, 1877; and two are from Halifax, Nova Scotia, September, 1877.

This species differs in color from the *borealis* in having the red more intense and arranged in clearly defined markings, of which those upon the carapax and abdomen are arranged in conspicuous, obliquely transverse lines or bars, while the color upon the rest of the body and upon the appendages is collected in distinct specks, blotches, or annulations.

Stimpson's *Pandalus levigatus* is undoubtedly synonymous with *P. Montaguï*. The latter species is exceedingly abundant in the Bay of Fundy and Dr. Stimpson could scarcely have failed to obtain it in his dredgings at Grand Menan. Moreover, the description of the *levigatus* applies perfectly to the *Montaguï*, except as to the color, in regard to which there was probably some mistake. There are similar discrepancies in regard to the color of some of the species of Amphipoda described in the same memoir.

#### *Palæmonetes vulgaris* Stimpson ex Say.

Kingsley (Proceedings Acad. Nat. Sci., 1878, p. 330 (15)) gives "Salem, Mass. (C. Cooke)," as a locality for this species, and it undoubtedly occurs regularly in the shallow waters of Cape Cod Bay, although I have never observed specimens north of Cape Cod. It is very common among eel-grass, etc., in Vineyard Sound! and Buzzard's Bay!, 1871, 1875; Fisher's Island Sound!, 1874; Long Island Sound!; south shore of Long Island!, 1870; New Jersey!, 1871; Fort Macon!, North Carolina (Coles, Packard); to the St. Johns River!, Florida (G. Brown Goode).

#### *Pasiphaë tarda* Krøyer.

*Pasiphaë tarda* Krøyer, Naturhistorisk Tidsskrift, II, i, p. 453, 1845; in Gaimard. Voyages en Scandinavie et Laponie, pl. 6, fig. 1 (*Pasiphaë*), 1849.—Lütken, in Manual of the Natural History of Greenland, for the use of the English Arctic Expedition, p. 148, 1875.—G. O. Sars, Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 342, 1877.

*Pasiphaë multidentata* Esmark, Christiania Videnskabs-Selskabs Forhandlinger for 1865, pp. 259, 316.

*Pastiphaë Norvegica* M. Sars, Christiania Videnskabs-Selskabs Forhandlinger for 1865. pp. 260, 314; Bidrag til Kunskaab om Christianiafjordens Fauna (extract Nyt Magazin for Naturvidenskaberne), p. 42, pls. 4, 5, figs. 65-90, 1868.—G. O. Sars. Undersøgelser over Christianiafjordens Dybvandsfauna (extract Nyt Mag. Nat.), p. 21, 1869; Christiania Videnskabs-Selskabs Forhandlinger for 1871, p. 262 (19), 1872.

Plate X, figure 1.

Gulf of Maine!, forty-two miles east by south from Cape Ann, about  $42^{\circ} 38'$  north latitude,  $69^{\circ} 38'$  west longitude, 160 fathoms, soft mud, August 19, 1877,—two specimens, 75 and 53<sup>mm</sup> in length. Also near the same locality, 140 and 175 fathoms, soft mud, August 27, 1878,—two specimens, one 62<sup>mm</sup> in length, the other fragmentary.

Greenland (Krøyer). West coast of Norway!, 100 to 525 fathoms (M. and G. O. Sars).

*Thysanopoda Norvegica* M. Sars.

Forhandlinger ved de Skandinaviske Naturforskere, 1856, p. 169, 1857; Christiania Videnskabs-Selskabs Forhandlinger, 1863, p. 2.—Goës, Æfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 173 (13).—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter, p. 15, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Vidensk.-Selsk. Forhandlinger, 1871, p. 262 (19); Archiv for Matematik og Naturvidenskab, Kristiania, ii, p. 342, 1877—(?) Norman, Last report on dredging among the Shetland Isles, Report British Assoc. Advanc. Sci., 1868, p. 265, 1869.—Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 285, 1874.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.

Massachusetts Bay!, off Salem, 48 fathoms, soft mud, 1877. Gulf of Maine!, off Massachusetts Bay and off Cape Ann, 1873, 1877 and 1878: 40 to 160 fathoms, mud, sand and mud, mud and stones. Casco Bay!, 1873: in great abundance at the surface on "mackerel ground," during both day and evening; also in dredgings from 64 and 94 fathoms, mud, off Casco Bay. Bay of Fundy!, 1864, 1868, 1870, 1872, 1876: in great abundance at the surface, and often brought up in the dredge. Several localities off the coast of Maine!, 95 to 105 fathoms, 1873, 1874. East of St. George's Banks!, 430 fathoms, 1872. Off Cape Sable!, Nova Scotia, 59, 88, and 115 fathoms, sand, gravel and stones, sandy mud, sand and gravel, 1877. Gulf of St. Lawrence!, 210 fathoms, mud, 1873. Greenland (Buchholz). North latitude  $75^{\circ}$ , east longitude  $12^{\circ}$  (Goës). West coast of Norway! (G. O. and M. Sars). North Sea (Metzger). (?) Shetland Islands (Norman).

Since this, as well as the next species, is essentially pelagic, swim-

ming in vast numbers at the surface, and doubtless at great depths as well, it is of course somewhat uncertain whether the specimens taken in the dredge really come from the bottom or from some point between that and the surface. It was found in the stomachs of the hake taken in the Bay of Fundy, in 1872, however, which is very good evidence that it lives at the bottom for a part of the time.

In the Bay of Fundy it occurs at the surface in vast swarms, filling the water for miles, and is usually accompanied by schools of mackerel, young pollock, and other fish, and in the autumn by immense flocks of gulls; the fish and smaller gulls appearing to feed almost exclusively upon the *Thysanopoda* at such times. It not infrequently occurs in this way in the harbor of Eastport, Maine, and, with a hand-net, may be caught by the quart even from the wharves. I have observed it only in August, September and October, but Messrs. Merriam and Wilson found it in abundance in April. Professor Verrill observed it, in 1859, swarming in myriads at the "Replings," in the center of the Bay of Fundy. In the Bay of Fundy, the *inermis* was often found associated with this species, but always in very much smaller numbers. The *Norvegica* occurred on "mackerel grounds" in Casco Bay, in the same way as in the Bay of Fundy, though not in such vast abundance.

In life, this species is very beautiful. The whole animal, except the black eyes, is very translucent; the edges of the carapax and the lower edges of the abdominal segments are faintly tinged with red; the upper surface of the carapax, the peduncles of the antennulæ and antennæ, and the cephalothoracic appendages are spotted and banded with deep bright red; the peculiar sense organs at the bases of the first and last pairs of pediform cephalothoracic appendages, and beneath the anterior segments of the abdomen are deep purplish red; the principal ganglia of the nervous system and many of the peripheral nerves are red, or tinged with red. The ganglia of the nervous system are sometimes, if not always, beautifully phosphorescent.

While at Casco Bay in August, 1873, and before I was aware of G. O. Sars' observations on the development of this species (in his zoological voyage of 1865, above referred to), several of the very remarkable larval stages of two species of *Thysanopoda*, most of the larvæ apparently belonging to this species, were found among the collections made at the surface with the towing-net in the evening. The youngest individuals observed belonged to the more common species, and, though apparently by no means the earliest of the free-

swimming stages, show close affinities with the nauplius-stage of the Copepoda, and at once convinced me of the correctness of the conclusions of Claus based on his earlier observations on *Euphausia*. In the earliest stage observed the animal is about  $2\frac{1}{2}$ mm long. The compound eyes are already present but are crowded closely together, sessile, and wholly covered above by the front of the carapax. The antennulæ and antennæ are highly developed biramus natatory appendages, the antennæ being still in the simplest naupliar form. The mandibles, both pairs of maxillæ, and the first pair of maxillipeds are developed and show considerable resemblance to the adult form of these appendages. The remaining cephalothoracic appendages have not yet appeared and the corresponding segments of the cephalothorax are only indicated by a closely crowded series of rather obscure annulations. The abdomen, however, is already well-developed and composed of the normal number of segments, and the uropods have even made their appearance in a rudimentary form. This earliest larval stage was unmistakably connected with the adult *Thysanopoda* by several intermediate stages found in company with the younger larvæ.

I should not have alluded to these very imperfect observations in connection with this subject, had not C. Spence Bate,\* having apparently overlooked Sars' observations, recently seemed to question the correctness of Claus' conclusions in regard to the larvæ referred by him to *Euphausia*.

I am able to throw no light whatever upon the question as to the manner in which the eggs are discharged or hatched, though it seems most probable to me that the eggs are discharged while the embryo is still immature and are hatched while floating in the water.

### *Thysanopoda inermis* Krøyer.

In Gaimard, Voyages en Scandinavie, en Laponie, au Spitzberg, pl. 7. fig. 2, 1849; Forsøg til en monographisk Fremstilling af Kræbstdyrslægten Sergestes, Kongl. Danske Vidensk. Selsk. Skr., V, naturvidensk. mathem. Afl., iv, pl. 5, fig. 24, 1856 (showing the peculiar sense organs).—Goës, Oversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 174 (14).—Reinhardt, Naturhistoriske Bidrag til en Beskrivelse af Grönland, p. 30, 1857 (extr. from Rink's Grönland).—Lütken, list of the Crustacea of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148.  
Mentioned, on my authority, as *T. neglecta*?, by Verrill, American Journal of Sci-

\* On the Nauplius Stage of Prawns, Annals and Magazine of Natural History, V, ii, p. 79, 1878.

ence, III, vii, p. 411, 1874. Also by Whiteaves, American Journal of Science, III, vii, pp. 213, 214, 1874; and Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873], p. 16, [1874?].

Very abundant at the surface in Vineyard Sound!, January 8, 1875, and January 14, 1876 (V. N. Edwards). Massachusetts Bay!, 48 fathoms, mud, 1877. Off the coast of Maine!, 102, 105 and 107 fathoms, mud and gravel, and mud, 1873, 1874. Bay of Fundy!, at the surface, 1864, 1868, 1872; dredged in 40 to 50 fathoms, rocky, 1868; and found in the stomachs of pollock and hake, 1872. Gulf of St. Lawrence!, 50, 70, 210 and 220 fathoms (J. F. Whiteaves). Greenland (Reinhardt, Lütken). Spitzbergen and Finmark (Goës). Lofoten Islands!, Norway (G. O. Sars).

The specimens taken in Vineyard Sound in winter are very slightly smaller and apparently more slender in form than the northern specimens taken in summer and autumn, but seem to differ in no other respect. Specimens from the Bay of Fundy agree perfectly with Krøyer's figures referred to above, and with specimens received directly from Prof. G. O. Sars and labeled by him *T. inermis* Krøyer. Specimens sent several years earlier from the same locality by Prof. Sars to the Smithsonian Institution, as a specimen of the food of *Gadus virens*, and labeled *T. neglecta* Krøyer, appear, however, to be the same species, and do not agree with Krøyer's figures of *T. neglecta*. It was an examination of these specimens which led me to label specimens of our species *T. neglecta*? for Prof. Verrill and Mr. Whiteaves.

In life this species is at once distinguished from the *Norvegica* by its much fainter coloring. It is exceedingly translucent, the sides of the carapax and abdomen, and the bases of the cephalothoracic and abdominal appendages are only slightly tinged with red. The nervous system and the peculiar sense organs, however, are brightly colored as in the *Norvegica*, and these together with the eyes are all that is easily visible as the animal swims gracefully about near the surface of the water.

### Erythrops Goësii G. O. Sars.

*Mysis erythrophthalma* Goës, Crustacea marina Suecicæ, (Eftversigt af Kongl. Vetenskaps-Akademens Förhandlingar, 1863, p. 178 (18), 1863.

*Nematopus Goësii* G. O. Sars, Beretning om en i Sommeren 1865 foretagen Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt. Mag. Nat.), p. 15, 1866.

*Erythrops Goësii* G. O. Sars, Carcinologiske Bidrag til Norges Fauna. Mysider, part

i, p. 24, pl. 1, 1870; Undersögelse over Hardangerfjordens Fauna, Crustacea, Christiania Videnskabs-Selskabs Forhandling, 1871, p. 262 (19), 1872.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.

Massachusetts Bay!, off Salem, August, 1877: 20 fathoms, rocks and gravel; 33 fathoms, sand and mud; and 48 fathoms, soft mud. Skager Rack, 49 fathoms (Metzger). West coast of Norway!, 30 to 150 fathoms (G. O. Sars). Spitzbergen (Goës).

### *Meterythrops*, gen. nov.

The large and very interesting species, for the reception of which this genus is here proposed, was first made known to me, several years ago, by a few, more or less imperfect, specimens dredged in the Gulf of St. Lawrence, in 1873, by Mr. J. F. Whiteaves, and, in his report on dredging for that year, it is referred to, on my authority, as a species "near to *Erythrops* and *Parerythrops*." The same species was dredged in 1877 by the party of the U. S. Fish Commission on board the "Speedwell," but only imperfect specimens were obtained. The following description and the accompanying figures are based on this meager material. The species combines several characters of the genera *Erythrops* and *Parerythrops* of G. O. Sars, but in general appearance is more like the latter genus. The new genus may be characterized as follows:

The body very short and obese with the posterior cephalothoracic segments almost completely covered above by the large and broad carapax. The eyes well-developed, large, nearly globular, and black after preservation in alcohol. The antennulæ, antennæ, and the oral and cephalothoracic appendages nearly as in *Parerythrops*. The pleopods in the female rudimentary and very nearly as in *Mysis*; in the male, as in *Erythrops*, all the five pairs being well-developed, biramous, and natatory; the inner ramus in the first pair, however, rudimentary and with the terminal part membranaceous, expanded, and nearly naked. The telson long, narrow, sub-triangular, the lateral margins naked, and the apex narrow, truncate, and armed with four spines and two median setæ. The ovigerous pouch composed of four large lamellæ nearly as in *Mysis*.

### *Meterythrops robusta*, sp. nov.

Plate XII, figures 1 and 2.

The carapax as seen from above is of nearly equal breadth to near the posterior extremity, where it is slightly contracted. The frontal

margin projects in an obtuse and rounded angle between the eyes, and, beneath the eye each side, the lateral margin projects into an acute and spiniform angle, just above which there is a deep sinus in the margin for the reception of the base of the antenna. The transverse sulcus is well-marked, strongly arcuate, and terminates each side just above the antero-lateral spine. The lateral margin is bent strongly upward in an obtuse angle at a point about a third of its length from the anterior margin. The posterior margin is only slightly emarginate. The eyes are very large, their greater diameter being more than a third of the breadth of the carapax, remote from each other, and attached by very slender bases; they are very nearly globular, though slightly flattened above, and the black, faceted area, occupying the greater portion of the surface, terminates in a regular and slightly arcuate line above. The peduncles of the antennulæ are only a little longer than the eyes, and the distal segment in each is as long as the two proximal, of which the second one is very short, not half as long as the first and much shorter upon the outer than upon the inner side. The flagella are stout and the outer longer than inner, as usual. In the adult male the segments of the peduncle are stouter than in the female, the basal and terminal segments each being as broad as long, and the distal segment terminates, beneath the base of the inner flagellum, in an obtuse, conical, and densely hirsute or ciliated process similar to that in the males of *Erythropus* and *Parerythropus*. The squamiform appendage of antenna (Plate XII, figure 2), is only about three times as long as broad, the greatest breadth being toward the distal extremity; the outer margin is nearly straight from near the base and terminates in a very large dentiform spine. From the base of this spine the anterior margin is very oblique, only slightly arcuate, scarcely longer than the breadth of the scale itself, and terminates in an oval tip which is about a third of the width of the scale in front of the tip of the lateral spine. The inner and terminal margins together are furnished with nearly fifty setæ, of which about a third are on the terminal margin. The peduncle of the antennula does not reach to the middle of the squamiform appendage, and the three distal segments are very short, the ultimate and antepenultimate each being about as broad as long and the two nearly equal in length, while the penultimate is shorter than either. The flagellum is stout and probably nearly as long as the rest of the animal, though, in all the specimens examined, the terminal portion is wanting.

The mandibles agree very closely, except in some of the details of

the armament of the coronal extremities, with the mandibles of *Parerythropros obesa*. In each mandible the inferior angle of the crown is separated by a broad space from the superior, or molar, angle. The inferior edges and the molar processes in both mandibles are almost exactly as in *Parerythropros obesa*: the inferior edge itself is much alike in the two mandibles, being composed of about four irregular, obtuse teeth, but the dentiform process just within the edge differs in the two mandibles; in the right it is more slender and prominent than in the left, and enlarges at the extremity, which is armed with several rather slender teeth; while in the left the process is shorter, stouter, and terminates in shorter teeth. The space between the armament of the inferior edge and the molar process is, in each mandible, furnished with twelve to fourteen setiform teeth which are very different in the two mandibles: in the left they are slender, crowded closely together, and armed with minute, spiniform teeth; while in the right they occupy a much larger space, are thin, acutely triangular, and wholly destitute of secondary spines or dentations, except, possibly, one or two exceedingly minute spinules at the bases of a few of them. The mandibular palpi have almost precisely the same form, proportions, and armament of spines and setæ as in *Parerythropros obesa*.

The first maxillæ are throughout exactly as in *Parerythropros obesa*. The second, also, have very nearly the same form and proportions as in that species; the outer lobe, or scaphognath, however, differs in being broadly oval, margined with twenty-five to thirty setæ, and in having the anterior extremity rounded and tipped with four setæ, two of which are very distinctly on the inner margin inside the tip, while in *Parerythropros obesa* the scaphognath is triangular anteriorly, is margined with only fifteen to eighteen setæ, none of which are really on the inner margin, although there are two at the narrow tip; the three lobes of the protognath and the two segments of the palpus (endognath) are exactly as in *Parerythropros obesa*, except that they are furnished with a few more setæ.

The endognath in the maxillipeds is almost exactly like this part of the same appendage in *Parerythropros obesa*. The exognath differs in being very slightly larger proportionally and in having thirteen or fourteen segments in the flagelliform portion. The endognath in the first gnathopods (second maxillipeds) does not differ from the same part in *Parerythropros obesa*, except that it is armed with a somewhat greater number of setæ and spines, particularly on the distal part of the outer margin of the longest segment (merus). The exognath is

exactly like that of the succeeding appendages: the base is very broad and muscular in both sexes, though somewhat broader in the males, and the outer distal angle projects in a distinct and rather acute tooth; and the flagelliform portion is composed of fifteen or sixteen segments.

The second gnathopods (third maxillipeds) and the five pairs of pereopods (cephalothoracic legs) are all alike in size and armament, the second gnathopods being apparently fully as long as the succeeding appendages. The length of the endognath in each is about equal to the length of the carapax, and the four distal segments (forming the "tarsus") are almost exactly equal in length to the three (basis, ischium and merus)\* which next precede them, the relative proportions of the different segments and their ratio to the rest of the animal being in fact almost exactly as in the pereopods of *Parerythropros obesa*. The endognaths of the second gnathopods and of the five pairs of pereopods are rather larger proportionally than in *Parerythropros obesa*, and, as in the exognath of the first gnathopods, the outer distal angle of the basal portion projects in an angular

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\* The distal portion of the pediform cephalothoracic appendages, which is normally composed of three segments, the carpus, propodus and dactylus, often contains in the Mysidæ more than the normal number of segments, and is well called the tarsus by G. O. Sars, in some of his recent papers. The additional segments appear to result from the segmentation of the carpal segment only, and I so regard them in this and the following descriptions. In the Caridea the carpal segments in some of the cephalothoracic legs are often divided or even multiarticulate, and that this is the normal segment which gives rise to the more or less numerous supplementary segments in the tarsus of the Mysidæ, is, I think, well shown in the second pair of gnathopods in the different genera of the family. In *Heteromysis* this portion of the tarsus is composed of the normal number of segments, although the carpus is very large and the propodus unusually short; in *Parerythropros obesa*, in the new species here described, and in the species of *Pseudomma*, the tarsus is composed of four segments but the division between the two first segments is very imperfect, admits of very little if any motion, and apparently has no special muscles attached near it, while the more distal articulations are of the ordinary character. In the new species of *Pseudomma* described beyond, this division of the carpus is so very incomplete that it is usually exceedingly difficult to discover it. It is evident that the four tarsal segments in the succeeding pairs of cephalothoracic appendages in *Parerythropros*, *Meterythropros* and *Pseudomma*, correspond to the four tarsal segments in the second gnathopods; and, in the absence of any facts to the contrary, it would seem proper to conclude that the ultimate and penultimate segments of the more or less numerous segmented tarsi of all the pediform cephalothoracic appendages of Mysidæ in general are homologous with the dactylus and propodus, and that the additional segments have all resulted from segmentation of the carpus.

tooth and the flagelliform portion is composed of fifteen or sixteen segments.

The abdomen is much narrower than the carapax and tapers only slightly; the first four segments are subequal in length, the fifth a little shorter, and the sixth a fourth longer than the fifth. The telson (Plate XII, figure 2 *c*) is as long as the sixth segment, narrow, triangular and twice as long as the width at base; the lateral margins are wholly unarmed and are suddenly expanded laterally near the base, but are nearly straight from this expansion to the tip. In the dorsal surface there is a deep median sulcus extending the whole length, and from this the surface slopes down each side to the lateral margin which is strongly upturned throughout. The extremity (figure 2 *d*) is very narrow, truncated in a straight line and armed with a median pair of slender spines of which the outer one is much shorter and more slender than the inner, which is itself about two-thirds as long as the space between the bases of the outer spines.

The inner lamella of the uropods (Plate XII, figure 2 *a*) reaches only a little beyond the tip of the telson, is expanded at the base for the reception of the acoustic apparatus, but beyond this is narrow and linear in outline; both margins are furnished with long ciliated setæ which are nearly twice as numerous on the inner as on the outer edge, and, in addition, the inner edge is armed beneath with a small spine at the base of each seta. The outer lamella is nearly a third longer than the inner, fully six times as long as broad, the greatest breadth being near the middle of the length, and both margins are regularly, though slightly, curved inward and each furnished with about equally numerous setæ.

The bases of all the pleopods in the male are rectangular in outline, and are very stout and muscular. The inner rudimentary ramus in the first pair of pleopods (Plate XII, figure 1 *a*) is soft, membranaceous, and about a third as long as the outer; the terminal portion is slightly swollen, and rounded at the extremity; and the lamellar appendage projecting outward from near the base, and corresponding to that upon the same ramus of the succeeding pleopods, has three or four hairs at the truncated tip and about the same number of shorter ones on the upper edge. The outer ramus in the first pair is, like the same ramus in the succeeding pairs, slender, much longer than the base, and composed of about fourteen segments. The inner rami of the second to the fifth pair of pleopods are similar to the outer, except that they all have the lamellar appendage near the base, like that upon the rudimentary ramus of the first pair, and usually

have one or more less segments than the corresponding outer branch. The number of segments in both the inner and outer rami varies somewhat, however: in the fully adult male, 28·5<sup>mm</sup> in length, there are fourteen segments in each of the outer rami of the first pair; twelve in the outer and thirteen in the inner of the second and third pairs; eleven in the inner and twelve in the outer of the fourth pair; and only eight in the inner and twelve in the outer of the fifth pair. In a young male, only 13·5<sup>mm</sup> long, there appear to be one or two less segments in each of the natatory rami of all the pleopods, although the rudimentary rami in the first pair, and the lamellar appendage of the inner ramus in the succeeding pairs, are well-developed.

The rudimentary pleopods of the female do not differ essentially from same appendages in the allied genera. They resemble more closely, however, the pleopods of the females of the species of *Mysis* than of *Parerythrops obesa*, the setæ with which they are armed being fewer in number and much longer than in that species.

Massachusetts Bay!, off Salem, 33 fathoms, sand and mud, August 4, 1877,—young male and female; also 33 fathoms, soft mud, August 13,—one young male. Off Bay of Chaleurs, Gulf of St. Lawrence!, 50 and 70 fathoms, 1873,—adult male and two females, one, 16·5<sup>mm</sup> long, the other, 14<sup>mm</sup>.

#### *Pseudomma roseum* G. O. Sars.

*Pseudomma roseum* G. O. Sars, Nye Dybvandscrustaceer fra Lofoten, Christiania Videnskabs-Selskabs Forhandling, 1869, p. 154 (10); Carcinologiske Bidrag til Norges Fauna, Mysider, part i, p. 54. pl. 4, 1870; Undersøgelser over Hardangerfjordens Fauna, Crustacea, Christiania Videnskabs-Selskabs Forhandling, 1871, p. 263 (20); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 344, 1877.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee. p. 288. 1875.—Whiteaves, Report on further deep-sea Dredging Operations in the Gulf of St. Lawrence [in 1873], p. 16. [1874?].

Near Jeffrey's Bank!, Gulf of Maine, 105 fathoms, brown mud, September, 1873,—one specimen. Gulf of St. Lawrence!, 1873, 28 miles east-northeast of Cape Gaspé, 110 fathoms; and 25 miles east by north of Cape Gaspé, 210 fathoms,—several specimens at each locality. West coast of Norway, at the Lofoten Islands!, 200 to 300 fathoms; and Hardanger Fiord, 100 fathoms, and between 400 and 500 fathoms (G. O. Sars). Off Mandel, southern Norway, 220 fathoms (Metzger).

*Pseudomma truncatum*, sp. nov.

## Plate XII, figures 3, 4.

This species is nearly allied to *P. roseum* and resembles it very closely in form and general appearance. The new species has proportionally shorter pereopods, however, and is readily distinguished by the terminal portion of the antennal scale and by the form of the telson.

The form and proportions of the carapax and abdomen are exactly as in *P. roseum*. The ophthalmic segment (Plate XII, figure 3 a) is a little broader in front than in *P. roseum*, the dentated portions of the margin are slightly more lateral and the dentations not quite as well-marked as in that species, and there seems to be less difference in the sexes in the form of the anterior margin. The antennulæ are as in *P. roseum*, except that the flagella are apparently a little shorter. The relative proportions of the segments of the peduncles of the antennæ are the same as in *P. roseum*. The squamiform appendage (figure 3) of the antenna is about three and a half times as long as broad; the outer margin is about five-sixths of the entire length and terminates in a stout tooth, as in the allied species; the inner margin is regularly arcuate and furnished with in the neighborhood of thirty setæ; the terminal portion, in front of the base of the terminal spine of the outer margin, is regularly and rather broadly ovate and not longer than the breadth of the scale; the setæ of the outer portion of the terminal margin, from the base of the lateral spine to near the tip, are nearly or quite twice as remote from each other as on the corresponding part of the inner margin, there being only three or four setæ until near the tip where there are three to five more, closely crowded together as on the inner margin. In *P. roseum* the terminal portion of the antennal scale is proportionally longer than in *P. truncatum*, being about one and a half times the breadth of the scale in advance of the base of the lateral spine, and the setæ on the outer portion of the terminal margin are as closely crowded as on the inner margin and twice or three times as numerous as in *P. truncatum*.

The oral appendages are as in *P. roseum*. The second gnathopods (third maxillipeds) have the same structure and proportions of the distal and proximal segments of the endopod, and the same number of segments in the flagelliform portion of the epipodal branches, as in *P. roseum*; but the three longest segments (the meral and the divided carpal), though varying considerably in different individuals of the same sex and size, and even on the different sides of the same

individual, are proportionally shorter than in that species, and consequently the entire endopod is correspondingly shorter, being only very slightly longer than the carapax. The articulation between the two divisions of the carpus is imperfect, very indistinct, and in some specimens is made out only with the greatest difficulty, even when the appendages in question have been specially mounted for the purpose; in *P. roseum*, however, this articulation is perfectly distinct as it is in the five pairs of pereopods in both species.

The five pairs of pereopods have precisely the same form and structure as in *P. roseum*, and, as in that species, increase successively in length posteriorly, but differ in the lengths of the three longest segments in the same way as the second gnathopods. In *P. truncatum* the length of the pereopods varies considerably in different specimens of the same sex and age, and even on the different sides of the same specimen, but the first pereopods are about a third as long as the entire body of the animal and the posterior pair are fully one-half as long, or about as long as the second pair in *P. roseum*.

The proportions of the segments of the abdomen are almost exactly as in *P. roseum*: the five anterior segments are sub-equal in length, though increasing very slightly posteriorly, and the fifth is about as broad as long and the first about a third broader than long; the sixth segment is about once and a half as long as the fifth and about two-fifths as long as broad. The telson (figures 3*b* and 4) is considerably shorter than the sixth segment, and, at base, about three-fourths as broad as long, sub-triangular, and truncated at the tip, which is about a third as broad as the base; the lateral margins are armed for a little more than the distal half of the length, with about seven small spines which are rather more crowded proximally; the tip is truncated and armed with two pairs of strong spines several times as long as those upon the lateral margins, and a median pair of slender plumose setæ, which are slightly longer in the male than in the female. In *P. roseum* the telson is as long as the sixth segment of the abdomen, the tip is rounded, and the lateral and terminal spines form a single series. The lamellæ of the uropods are somewhat shorter and broader in proportion to the length, but absolutely of about the same breadth as in *P. roseum*.

Gulf of St. Lawrence!, 1873 (J. F. Whiteaves): off the Bay of Chaleurs, 50 and 70 fathoms, August 4,—between twenty and thirty specimens; and also between Bradelle Bank and Miscou Island, 45 fathoms, mud and stones, August 7,—one male.

## Heteromysis.

*Heteromysis* Smith, Invertebrate animals of Vineyard Sound, in Report of U. S. Commissioner of Fish and Fisheries, part i, p. 553 (259), 1874.

*Chiomysis* G. O. Sars. Middelhavets Mysider, Archiv for Mathematik og Naturvidenskab, Kristiania, ii. p. 56 (48), pls. 19, 20. 1877.

Professor Sars' *Chiomysis microps*, described from females only, is unquestionably congeneric and specifically very closely allied to my species mentioned below. As pointed out both by Professor Sars and myself, the most conspicuous characteristic of the genus is in the structure of the endognath of the second pair of gnathopods (third maxillipeds, or, according to Sars, first legs), which are very unlike the pereopods, being longer, very much stouter, with the terminal, or "tarsal," portion composed of the three normal segments, of which the proximal (carpus) is about as large as the preceding segment (merus), the two distal segments very short, the propodus being as broad as long and the dactylus forming a terminal claw; while the five pairs of pereopods are as in the genus *Mysis*. The male affords additional generic characters, in having all the pleopods like those of the female (in which they are as in *Mysis*), and in having no prominently projecting sexual appendage upon the peduncles of the antennulæ, but in its place only a slightly raised and nearly transverse elevation, densely clothed with hairs.

*Heteromysis formosa* Smith, loc. cit.

New Haven!, Connecticut. Tide-pool at Thimble Islands!, near New Haven (A. E. Verrill, 1874). Gardener's! and Peconic! Bays, 1874. Vineyard Sound! and Buzzard's Bay!, surface to 10 fathoms in depth, 1871, 1875. "Among weeds, Haste Island," Salem!, Massachusetts (J. H. Emerton, 1878).

Although very closely allied to the Mediterranean species, the *H. formosa* is readily distinguishable by the following characters. The stout carpal segment in the second pair of gnathopods, in the female, is armed along the distal half of the inner margin with six to eight slender spines in place of the four in *H. microps*, and there are in addition twelve to fifteen setæ longer than the spines and extending nearly the whole length of the margin. In the male, however, this segment is a little more slender and has fewer spines and setæ than in the female. The short propodal segment, as seen in a side view, is nearly square, its distal margin being parallel with the proximal and having no angular prominence on the inner side as in *H. microps*. The inner lamellæ of the propods are nearly as long as the outer,

taper distally more than in *H. microps*, and the inner margin in each is armed with a series of twelve to eighteen slender spines, extending almost to the tip, in addition to the long setæ, while in *H. microps* there is only a single spine near the base. The telson differs from that of *H. microps* in having the lateral margins incurved at the tips and each armed with eleven to sixteen spines, of which nearly all are on the distal half of the margin and all placed at nearly equal distances from each other, none of the proximal ones being scattered from the series as in *H. microps*; the terminal spine each side has no small spine at its base but stands entirely alone; the sinns of the terminal margin is broad and broadly rounded at the proximal end, its lateral margins are nearly straight instead of convex in outline, and there are only fourteen to twenty spines on the entire margin.

All the specimens I have examined have been taken in August and September and a large proportion of the individuals are females carrying eggs or young. The species was never found in abundance except hidden away inside dead bivalve shells, usually *Mactras*, dredged in 5 to 10 fathoms. As many as twenty were sometimes found in a single shell. The males and young were occasionally taken at the surface in the evening in Vineyard Sound.

### *Mysis mixta* Liljeborg.

*Mysis mixta* Liljeborg, Hafs-Crustaceer vid Kullaberg, (Efvorsigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, pp. 3, 6.—Goës, Crustacea decapoda Sueciae, Efvorsigt af Vet. Akad. Förhand., 1863, 175 (15).—G. O. Sars, Undersøgelser over Christianiafjordens Dybvandsfauna, 35, 1869 (extr. Nyt Magazin Naturvidenskaberne); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 344, 1877.

?*Mysis latitans* Krøyer, Et Bidrag til Kundskab om Krebsdyrfamilien Mysidæ, Naturhistorisk Tidsskrift, III, i, p. 30, pl. i, fig. 4, 1861.

Massachusetts Bay!, off Salem, 1877: 20 fathoms, gravel, August 6,—more than 200 specimens: abundant, also in August, in 22 fathoms, gravel; 33 fathoms, sand and mud; 33 fathoms, soft mud; and 35 fathoms, mud and clay nodules: common in 48 fathoms, mud, August 13. Gulf of Maine!, off Cape Ann, 1877: common at 90 fathoms, mud, August 14, and at 50 fathoms, mud, gravel and rocks, October 17. Off Cape Ann!, 54 fathoms, gravel and stones, 1873. Also abundant, in 30 to 50 fathoms, muddy and gravelly bottoms, at various localities off Cape Ann!, 1878. Casco Bay!, August, 1873: six miles southeast from Seguin Island, 35 fathoms, mud; about seventeen miles off Cape Elizabeth, 64 fathoms, mud; and about

twenty miles off, 68 fathoms, mud. Bay of Fundy, 1864,—one specimen. ? Greenland (Krøyer,—*M. latitans*). Iceland (G. O. Sars). Finmark (Goës), Lofoten Islands! and Christiania Fiord (G. O. Sars). Baltic (Liljeborg, et al.).

All the American specimens examined were taken between August 4 and October 17; most of them are young, between 12 and 20<sup>mm</sup> long, a few, however, are females, from 20 to 25<sup>mm</sup> long, with nearly fully developed ovigerous lamellæ, but none of them carrying eggs. This seems to show that the breeding season is during the winter, and it apparently indicates that the species is an annual like *M. mixta*.

### *Mysis stenolepis* Smith.

? *Mysis spinulosus* Gould, Report on the Invertebrata of Massachusetts, 1st edit., p. 333, 1841 (not of Leach).

*Mysis stenolepis* Smith, Report on the Invertebrate Animals of Vineyard Sound, Report, U. S. Commissioner of Fish and Fisheries, part i, p. 551 (257), pl. 3, fig. 12, 1874.

New Haven!, Connecticut, among eel-grass. Noank!, Connecticut, among eel-grass, etc., 1874. Vineyard Sound! and Buzzard's Bay!, among eel-grass, and also dredged in a few fathoms among algæ, 1871, 1875. Gloucester!, Massachusetts, 7 to 10 fathoms, sand and red algæ, 1878. Casco Bay!, 1873: Portland Harbor, among eel-grass; Quohog Bay, among eel-grass; between Overset Island and Peak's Island, 18 fathoms, rocks and sponges; and off Ram Island, 18 fathoms, mud. Halifax!, Nova Scotia, 1877: Onter Harbor, 16 to 21 fathoms, fine sand, stones, and red algæ; also, 18 fathoms, mud and fine sand.

This species, although very closely allied to *M. mixta* is certainly distinct. The antennal scales in *stenolepis* are much longer and proportionally narrower toward the base than in the allied species (in the full-grown female the greatest breadth being contained in the length about twelve times in *stenolepis*, and scarcely nine times in *mixta*), and nearly the whole outer margin of the scale is concave in outline in *stenolepis*, while in *mixta* it is nearly straight, or even slightly convex toward the base, where the concavity is usually greatest in *stenolepis*. The two distal segments of the antennular peduncle are nearly equal in length in *stenolepis*, the penultimate being only very slightly the longer; while in *mixta* the penultimate is fully a third longer than the ultimate and absolutely longer than in *stenolepis* (the length of the penultimate segment being contained in the

length of the antennal scale little over six times in *mixta*, but about ten times in *stenolepis*.

The sinus of the posterior margin of the telson is much broader and deeper in *mixta* than in *stenolepis*, but the edges of the sinus are armed with fully as many spines in *stenolepis*, so that they are much more closely crowded. The spines of the lateral margins of the telson are fewer and rather larger in *stenolepis* (there are usually twenty-four or twenty-five spines each side in the adult *stenolepis*, and over thirty in *mixta*) and do not extend to so near the tip, the most posterior spines in *stenolepis* arising very little if at all back of the bottom of the sinus of the posterior margin, while in *mixta* there are at least three or four spines arising back of the bottom of the sinus. A part of this last difference is due to the greater depth of the sinus in *mixta*, but the terminal portion of the margin back of the spines is absolutely fully twice as long in *stenolepis* as in *mixta*.

The coloration, even in ordinary alcoholic specimens, affords the readiest means for distinguishing the two species, however. In *mixta* there is a small arborescent spot of black pigment upon the upper side of the last cephalothoracic segment, upon each of the segments of the abdomen except the sixth, one each side at the base of the telson, and beneath upon the ovigerous lamellæ and upon each of the first five segments of the abdomen; there are similar but much smaller spots upon the bases of the antennulæ and antennæ and usually two minute ones on the distal half of the antennal scales; but with the exception of these pigment spots and the eyes, the entire animal is opaque white, turning to grayish white in alcohol. In specimens which have been preserved in alcohol for a very long time, the pigment spots often become obscure or wholly obliterated. In *stenolepis*, on the other hand, the peduncles and inner flagella of the antennulæ, the scales of the antennæ, the dorsal sides of the eye-peduncles, the dorsal surface of the whole abdomen, the telson, and both lamellæ of the uropods are covered with widely and thickly branching ramifications of numerous large pigment spots. The color is particularly conspicuous upon the peduncles and inner flagella of the antennulæ and upon the antennal scales, all which parts of the animal appear very dark or often almost black. There is considerable variation in the amount of pigment in different individuals, but in all the specimens examined it is invariably present upon all the parts above mentioned, and is still very conspicuous in specimens which have been preserved in alcohol for many years.

This difference in the coloration of the two species is undoubtedly

a result of the difference in their habitats, the *stenolepis* being confined to shallow water where the bottom is overgrown with eel-grass or algæ, abounding particularly among eel-grass during the summer and autumn; while the *miata* is apparently confined to deeper, and, at least in summer, very much colder, water, ranging from twenty to a hundred or more fathoms, where there is no eel-grass and seldom, if ever, algæ.

The *stenolepis* is an annual species; the young appear in early summer, come to maturity early in the winter, produce young from mid-winter to spring, and all the mature individuals disappear before the second summer, the males disappearing long before the females. The following tabulation of the results of an examination of several collections made at different seasons of the year, illustrates this fact.

Locality.	Date.	No. of specimens, age and sex.	Length in mm.	Remarks.
Vineyard Sd..	July 4	10 +; young.	10 to 15	Among eel-grass.
Casco Bay,	14	50 + "	10 to 18	" "
"	16	100 + "	12 to 18	" "
"	Aug. 19	200 + "	15 to 18	" "
Halifax,	25	2 "	14	16 fathoms, algæ.
Casco Bay,	27	20 + "	15 to 20	18 fathoms, rocks and sponges.
Vineyard Sd.,	Sept. 2	3 "	17	Taken at surface.
Halifax.	6	9 "	14 to 16	16 fathoms, sand and algæ.
"	15	8 "	14 to 16	18 fathoms, mud and sand.
Vineyard Sd.,	Dec. 13	80; females.	25 to 30	Ovigerous sacs well developed and many filled with eggs.
"		16; males.	21 to 24	
"	Jan. —	100 +; females.	24 to 28	Ovigerous sacs well developed and nearly all filled with eggs.
"		1; male.	21.5	
"	April 3	50 +; all females.	25 to 29	All with fully developed young or empty ovigerous sacs.
"	24	100 +; "	25 to 30	Mostly with empty ovigerous sacs.
"	May 12	100 +; "	25 to 29	All, or very nearly all, with empty ovigerous sacs.

### *Mysis oculata* Krøyer ex O. Fabricius.

*Mysis spinulosus* Packard. Canadian Naturalist and Geologist, vol. viii, p. 419, 1863.

*Mysis oculata* Packard. Memoirs Boston Society Nat. Hist., vol. i, p. 301, 1867.

Labrador!, "abundant along the whole coast" (Packard). Grinnell Land, as far north as latitude 79° 29' (Miers). Greenland (Krøyer, Stimpson, et al.). Iceland (G. O. Sars). Buchholz and Miers each include Spitzbergen among the habitats of this species. The very closely allied form, *M. relicta* Lovén, by Professor G. O. Sars regarded as only a variety *M. oculata*, occurs in the Gulf of Bothnia (G. O. Sars), in the fresh-water lakes of southern Scandinavia! (Lovén, G. O. Sars), and in Lakes Michigan! and Superior!

Stimpson (Marine Invertebrata of Grand Manan, p. 58), reports this species (with an?) as "very abundant in the waters at the mouth of the Bay of Fundy, swimming near the surface in swarms." I have never seen specimens from the Bay of Fundy, and, during several seasons spent there, I have never observed any species of *Mysis* swimming at the surface, as described by Stimpson. *Thysanopoda Norvegica* and *inermis*, however, were found in vast numbers in precisely the same way as the *Mysis* is said by Stimpson to occur, and it is possible that Stimpson, without making a special examination, mistook the vast swarms of *Thysanopoda* for *Mysis oculata*.

### *Mysis Americana* Smith.

*Mysis Americana* Smith, Report on the Invertebrate Animals of Vineyard Sound. Report U. S. Commissioner of Fish and Fisheries, part i, p. 552 (258), 1874.

Great Egg Harbor!, New Jersey, 1871,—in pools on salt-marshes, and in great abundance in the stomachs of the ocellated flounder (*Chenopsetta ocellaris*), the spotted flounder (*Lophosetta maculata*), and the shad. Stomach of shad!, Great South Bay, Long-Island, May 21, 1875. New Haven!, Connecticut,—abundant among seaweed, etc., May, 1873 (A. E. Verrill and D. C. Eaton); and in great abundance among hydroids, etc., under wharves, May, 1875 (S. F. Clark); also dredged in 4 to 5 fathoms. Vineyard Sound!, young occasionally taken at the surface in summer, 1871, 1875; also in the dredge from 25 fathoms, but probably taken on the way up; and common in the stomachs of shad, mackerel, and sea-herring. Portland Harbor!, Casco Bay, taken at the surface and dredged in 3 fathoms, mud, 1873.

This species breeds during the spring and summer, and very likely during the larger part of the year, since the young and old are often found together in spring and summer. The males are nearly or quite as large as the females. Females carrying eggs or young vary, in a large lot from New Haven, from 10 to 14<sup>mm</sup> in length, and many of the males in the same lot are of the latter length. One egg-carrying female from Casco Bay is only 9.5<sup>mm</sup> long.

The *Americana* is closely allied to *M. vulgaris* of Europe, but is very readily distinguished by the telson, the lateral margins of which are armed with spines of nearly uniform size in *vulgaris*, while in *Americana* they are armed with stout spines alternating with intervals of several smaller ones. There are numerous other, but less conspicuous differences.

## CUMACEA.

The following account of the Cumacea is even more imperfect than the enumeration of the species of the groups treated above. No reference is made to a few small species, which are represented in the collections examined by young or imperfect specimens only. Several of the species were first very kindly determined for me several years ago by Professor G. O. Sars.

*Diastylis Rathkii* Bate.

*Cuma Rathkii* Krøyer, Naturhistorisk Tidsskrift, iii, pp. 513, 531, pls. 5, 6, figs. 17-30, 1841 (♀); *ibid.*, II, ii, pp. 145, 207, pl. 1, figs. 4 and 6, 1846: in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5, fig. 1, 1849.—Liljeborg, Æfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, p. 6.—Möbius, Die wirbellosen Thiere der Ostsee, Exped. 1871 auf Pommerania, p. 122, 1873.

*Cuma angulata* Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 156, 206, pl. 2, fig. 1, 1846; in Gaimard, *op. cit.*, pl. 5, fig. 2, 1849 (♂).

*Diastylis Rathkii* Bate, Annals and Magazine Nat. Hist., II, xvii, p. 451 (3), pl. 13, figs. 1-21, 1856.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 160; Om Cumaceer fra de store dybder i Nordishafvet, Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, xi, no. 6, p. 7, pl. 3, figs. 8-9, 1873; Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1875.—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 286, 1875.

*Alauna Goodsiri* Packard, Memoirs Boston Soc. Nat. Hist., i, p. 301, 1867. (Not of Bell, in Belcher, Last of the Arctic Voyages in search of Sir John Franklin, ii, p. 403, pl. 34, fig. 2, 1855; though it is very probably the species mentioned by Bell as perhaps a form of his species and partially figured on the same plate, figure 3, with which figure Packard identified his specimens.)

Off Halifax!, Nova Scotia, 1877: 42 fathoms, fine sand,—five males, six females; 52 fathoms, fine sandy mud,—one male, seven females; 57 fathoms, gravel and stones,—one specimen. Also just off Chebucto Head!, Halifax, 1872, 20 fathoms, soft mud and fine sand,—young only. Gulf of St. Lawrence!, 1871, 1872, 1873 (Whitceaves). Labrador! (Packard). Greenland (Krøyer, Norman). North latitude 81°, east longitude 1°, 450 fathoms (G. O. Sars). British Isles! (Norman). Norway! (G. O. Sars). Baltic! (Möbius).

In 1873 I sent some of the specimens collected on the coast of Labrador by Prof. Packard, to Prof. G. O. Sars and he wrote me that they belonged to a new species, but I am unable to find any constant differences which will distinguish the specimens which still remain from Prof. Packard's collection from European specimens of *D. Rathkii*. Most of the specimens from Labrador have the sides of

the anterior part of the carapax a little smoother than usual in the species, but the difference is very slight and apparently not constant, and it may be due to the bad state of preservation of the specimens. The specimens from off Halifax, and most of those from the Gulf of St. Lawrence, agree perfectly with the European specimens which I have examined.

*Diastylis politus*, sp. nov.

*Adult female*.—The cephalothorax is elongated and, including the lateral spiniform processes of the last segment, nearly half as long as the length from the tip of the rostrum to the tip of the telson, pretty regularly oval in outline as seen from above, and regularly and strongly convex dorsally as seen from the side. The carapax is rather more than half as long as the whole cephalothorax, about three-fourths as broad as long, and very much longer than high. The posterior edge is regularly arcuate and has an elevated margin which extends round the broadly sinuous inferior edge to an angular prominence below the base of the rostrum as in *D. sculptus*, and the anterior portion of the inferior edge is minutely dentate as in that species. The rostrum is short, nearly horizontal, and rather obtuse as seen from above.

The surface of the carapax is naked and nearly smooth, except that the anterior portion is areolated somewhat after the manner of *D. sculptus*, but the areolations are fewer and less deeply excavated, and they do not extend to the postero-lateral portions of the carapax as in that species. As seen from above, there are two minutely dentate transverse crests, as in *D. sculptus*, upon the semi-circular median lobe, and the posterior of these extends across the lobe and connects with a perpendicular crest which extends in a nearly straight line to the lateral margin just back of the angular prominence below the base of the rostrum. In front of this vertical crest each side there is a short and prominent crest, slightly curved and nearly parallel with the inferior margin, but which does not reach the inferior margin of the rostrum and fades out posteriorly before it reaches the vertical crest. Just back of the first vertical crest, is a second which curves sharply forward and connects with the first below, but which is straight and slightly diverges from the first above. At the suture round the median lobe this second crest is connected with the first by a short ridge, so as to leave a nearly square area, as in *D. sculptus*, each side of the median line, as seen from above, and just back of the posterior transverse crest of the median lobe. Just back of the upper

part of this second vertical crest, there is each side a similar but less conspicuous crest parallel with the second, but extending only a short distance from the median line. The whole postero-lateral region of the carapax is unsculptured and nearly smooth.

Of the five free segments of the cephalothorax, the first and second are nearly as in *D. sculptus*, except that the lateral expansion of the second segment, just above the attachment of the leg each side, projects more abruptly and further anteriorly, so as to overlap the first segment and nearly reach the margin of the carapax. The third and fourth segments together are a little broader than the first and second, but the third is only about half as wide as the fourth and is closely consolidated with it above. The lateral portions of these segments are very much as in *D. sculpta*, except that the third segment projects slightly forward, as well as backward, above the base of the leg each side. The fifth segment projects back each side and terminates in a slender spiniform process over the base of each leg as in *D. Rathkii*. The three last segments in fact resemble the corresponding parts of *D. Rathkii* much more nearly than those of *D. sculptus*.

The antennæ and the three pairs of maxillipeds are almost exactly as in *D. sculptus*. The first cephalothoracic legs are a little shorter than in that species, the distal end of the propodus only just about reaching to the tip of rostrum, but the relative lengths of the segments themselves are about the same. The second legs are of about the same length relatively as in *D. sculptus*, but the proportions of the segments are different, the carpus being conspicuously long and slender. The stout curved basis is about as long as the merus and carpus combined, and is margined below with ciliated setæ. The carpus is very slender, longer than the combined lengths of the merus, propodus and dactylus, and naked except a few short hairs on the outer side and a group of slender setæ at the distal extremity. The propodus and dactylus are correspondingly slender, the dactylus slightly the longer, and the combined length of the two segments is only slightly more than half the length of the carpus. The third, fourth and fifth legs are nearly as in *D. sculptus*, but the carpal segments are only about three-fourths as long as the meral.

The abdomen, to the tip of the telson, is only slightly longer than the cephalothorax, and all the segments, except the telson, have very nearly the same form and proportions as in *D. sculptus*. The telson is about as long as the fifth segment, broad at the base and abruptly narrowed to a slender terminal portion scarcely longer than the stout basal part, and the slender portion is armed with only six to nine

pairs of spines. The basal portions of the uropods are about a fourth longer than the telson, slender, and each armed along the distal three-fourths of the inner side with a series of ten to twelve small spines which become more scattered proximally and never extend to the base. The inner ramus is about two-thirds as long as the base, composed of two segments, slender, tapers to a long and slender spiniform tip, and is armed along the inner edge with eight to ten spines, of which four are usually upon the basal segment, and one, or sometimes two, upon the outer edge. The outer ramus is somewhat longer than the inner, slender, tipped with two long setiform spines, and armed upon the outer edge with six to ten very slender spines, but with only a single spine upon the inner margin near the tip.

The *adult male* differs from the female in being more slender, in having the cephalothorax much more compressed vertically, and, as usual in the genus, in the structure of the antennæ, the anterior abdominal appendages, etc. The carapax is much more depressed than in the female, the height being less than half the length, and much broader and more obtuse anteriorly as seen from above. The surface is more conspicuously punctated than in the female, but the anterior portion is areolated in the same manner, except that there is in addition a prominent longitudinal carina-like crest each side, extending in a straight line from the inferior margin just in front of the postero-lateral angle to the sharp curve at the lower end of the second vertical crest. The margin of the carapax below this is incurved much more abruptly than in the female, so that the sides of the carapax are angulated each side at the widest part,—almost exactly as in the male of *D. Rathkii*. The telson is much longer than in the female, has the usual sharp dorsal angle between the basal and terminal portion, and is armed with eight to ten pairs of slender spines which are longer than in the female. The bases of the uropods are armed with ten to sixteen spines, and the inner edge of the inner ramus with twenty-four to thirty spines, of which ten to twelve are on the basal segment.

This is a much larger species than *D. sculptus*, the length of the adult female, from tip of rostrum to extremity of telson, being about 12<sup>mm</sup>; of adult male, about 14<sup>mm</sup>.

In life the males, at least, are semi-translucent, whitish, with the ophthalmic lobe pink.

Vineyard Sound!, July 20, 1875,—one young male taken at the surface. Adult males were taken at the surface at the same locality, by Mr. Vinal N. Edwards, December 8, 1875, March 22, 1876, April,

1877; adult males and a female carrying eggs, May 2, 1878; and a young specimen January 20, 1876. Gloucester!, Massachusetts, 7 to 10 fathoms, sand and red algæ, August, 1878,—the young abundant, the adult females, carrying eggs and young, common, but the adult males rather rare. Casco Bay!, August, 1873: 9 fathoms, sand and mud,—one male and four egg-bearing females; also at other depths; and the young taken at the surface, in the evening. Trenton Bay!, coast of Maine (A. E. Verrill). Halifax!, Nova Scotia, 18 to 20 fathoms, fine sand, stones and red algæ, 1877. Also one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles, 1877,—two egg-bearing females. Northumberland Straits, Gulf of St. Lawrence!, 1873 (J. F. Whiteaves).

### *Diastylis sculptus* G. O. Sars.

*Diastylis sculpta* G. O. Sars, Æfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 71; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 24, pls. 1 to 9, figs. 1-49, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i, p. 554 (260) 1874; Transactions Connecticut Acad., iii, p. 29, 1874.

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand; and off Watch Hill!, Rhode Island, 18 fathoms, 1874. I have no record of the dredging of this species in Vineyard Sound, but it was not uncommon in collections made at the surface, during July, August and September, 1871 and 1875. Most of these specimens are females or young and were taken both during the day-time and evening; adult males occurred rarely, however. A single adult specimen of the male was also collected at the surface, at the same locality, in April, 1877, by Vinal N. Edwards. Gloucester Harbor!, Massachusetts, 7 to 10 fathoms, sand and red algæ, 1878. Also off Gloucester! and off Cape Ann!, 1878: 26 fathoms, sand, gravel and stones; 35 fathoms, sand; 33 fathoms, sand and gravel. Casco Bay!, 1873; at the surface in the evening; among Laminaria; 9 fathoms, sand and mud; 17 fathoms, mud; 27 to 34 fathoms, hard bottom. Bay of Fundy!: found at low-water mark!, in sandy mud, 1868; at the surface, at low-water mark, and in 4 fathoms, very soft mud, 1872; also in 60 fathoms, mud, off Head Harbor, 1872. Near Halifax!, Nova Scotia, in company with *D. Rathkii* and *D. quadrispinosus*, 20 fathoms, soft mud and fine sand, 1872. Halifax Harbor!, 16, 18 and 21 fathoms, fine sand, stones and red algæ, 1877. About one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles,

1877,—ten large females, all carrying eggs. Northumberland Straits, Gulf of St. Lawrence!, 10 fathoms, sand (J. F. Whiteaves).

*Diastylis luciferus* Danielssen.

*Cuma lucifera* Krøyer. Naturhistorisk Tidsskrift, iii. pp. 527, 531. pl. 6, figs. 34–35. 1841: *ibid.*, II, ii, p. 171, 207, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 3, fig. 3, 1849.—Liljeborg. Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 119.

.. *Diastylis lucifera* Danielssen. Beretning om en zoologisk Reise i Sommeren 1858 i Thronhjemske Vidensk. Selsk. Skrifter, iv, p. 108" (G. O. Sars).—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 161; Undersøgelser over Christianiafjordens Dybvandsfauna (extr. Nyt Magazin for Naturvidenskaberne), p. 38, 1869; Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 269 (26); Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceer, Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873. Nordsee, p. 286, 1875.

? *Diastylis borealis* Bate. Annals and Magazin Nat. Hist., II, xv, p. 85, pl. 1, fig. 3, 1865 (Port Kennedy, north latitude 72°, west longitude 94°).

Bay of Fundy!, 60 and 77 fathoms, mud, off Head Harbor, August 16, 1872. About ten miles north of Shediac, Gulf of St. Lawrence! (J. F. Whiteaves). Scandinavia! (G. O. Sars, et al.)

*Diastylis quadrispinosus* G. O. Sars.

*Diastylis quadrispinosa* G. O. Sars, Öfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 72; Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceer, Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 28, pls. 10, 11, figs. 51–61, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner of Fish and Fisheries, part i, p. 554 (260), pl. 3, fig. 13, 1874; Transactions Connecticut Acad., iii, p. 28, 1874.

*Cuma bispinosa* Stimpson, Invertebrata of Grand Manan, p. 30, 1853 (description insufficient. Not the European *Diastylis bispinosa* G. O. Sars (*D. bicornis* Bate)).

Off the coast of New Jersey, north latitude 39° 54', west longitude 73° 15', 30 to 35 fathoms, and off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand and mud, 1874. Off Watch Hill!, Rhode Island, 18 fathoms, 1874. Off Buzzard's Bay! 29 fathoms, fine sandy mud, common, 1871. Off Martha's Vineyard!, 23 fathoms, 1871. Southwest Ledge!, off Martha's Vineyard, 18 fathoms, 1875. Vineyard Sound, off Tarpaulin Cove!, 10 to 12 fathoms, 1875: Massachusetts Bay!, off Salem, 20 fathoms, gravel and stones, 1877. Off Cape Ann!, Massachusetts, 1878: 26 to 33 fathoms, sand, gravel and stones; 35

fathoms, sand, very abundant. Between Cape Ann and the Isles of Shoals!, 43 to 68 fathoms, mud, 1874. Jeffrey's Ledge!, Gulf of Maine, 51 fathoms, hard sandy mud, 1874. Cosco Bay!, 1873: 16 and 17 fathoms, mud, abundant; 27 fathoms, off Halfway Rock; 45 fathoms, off Seguin Island; also taken with numerous Amphipoda, in 2 fathoms, muddy bottom, in a small trap baited with pieces of fish. Bay of Fundy!, 1868, 1870, 1872. In 1872 it was also dredged in vast numbers at Eel Cove, Grand Menan, in 8 to 10 fathoms, sand, by Prof. H. E. Webster. Off Cape Sable!, Nova Scotia, 75 fathoms, fine sand and mud, 1877. In and near Halifax Harbor!, Nova Scotia, 1872, 1877: 20 fathoms, soft mud and sand; 16 and 18 fathoms, fine sand and red algæ; 21 fathoms, sand, stones and algæ; 42 fathoms, fine sand; 52 fathoms, fine sandy mud. Also about one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles, 1877. Northumberland Straits, Gulf of St. Lawrence!, 1873 (Whit-eaves).

Upon the coast of northern New England, this is by far the most abundant species of the genus. It is undoubtedly the species which Stimpson called *Cuma bispinosa*, but his description is wholly insufficient to characterize the species and I therefore prefer to retain the more appropriate name proposed by G. O. Sars, who has described and figured the species most admirably. Professor Sars has identified specimens which I have sent to him from different localities on the New England coast.

*Diastylis bicornis* Bate, is a very different species, of which I have examined European specimens, but which I have never seen upon the American coast.

#### *Diastylis abbreviatus* G. O. Sars.

*Diastylis abbreviata* G. O. Sars, Æfversight Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 74; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 30, pl. 12, figs. 62-64, 1871.

Very rare in 30 to 35 fathoms, off the coast of New Jersey, north latitude  $39^{\circ} 54'$ , west longitude  $73^{\circ} 15'$  (Josephine Expedition, Sars). Off Cape Ann!, 35 fathoms, sand, 1878,—one specimen among great numbers of *D. quadrispinosus*. Casco Bay!, 1873: 17 fathoms, mud; also at one other station.

This very pretty species appears to be rare.

**Leptostylis longimanus** G. O. Sars.

*Diastylis longimana* G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 173; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 23, 1866 (extr. Nyt Magazin for Naturvidenskaberne).

*Leptostylis longimanu* G. O. Sars, Christianiafjordens Dybvandsfauna, p. 39, 1869 (extr. Nyt Mag. Nat.).

A single female, apparently of this species, was dredged in Casco Bay!, in 1873. It seems to have been known previously only from the coast of Norway (G. O. Sars).

**Leptostylis ampullaceus** G. O. Sars.

*Cuma ampullacea* Liljeborg, (Efversight Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 120.

*Diastylis ampullacea* G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 175; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne).

*Leptostylis ampullacea* G. O. Sars, Christianiafjordens Dybvandsfauna, p. 40, 1869 (extr. Nyt Mag. Nat.); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1877.

Gulf of Maine, near Cashe's Ledge!, 52 to 90 fathoms, 1873,—a single specimen.

**Leucon nasicus** Kröyer.

*Cuma nasica* Kröyer, Naturhistorisk Tidsskrift, iii, pp. 524, 532, pl. 6, figs. 31-33, 1841.

*Leucon nasica* Kröyer, Naturhistorisk Tidsskrift, II, ii, pp. 189, 209, pl. 2, fig. 5a-b, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 3, fig. 2, 1849.—Liljeborg, (Efversight Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 121.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 178 (*nasicus*); Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Christianiafjordens Dybvandsfauna, p. 41, 1869 (extr. Nyt Magazin for Nat.); Christiania Videnskabs-Selskabs Forhandling, 1871, p. 27 (270).—Whiteaves, Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873] p. 16, [1874?].—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 286, 1875.—Norman, Annals and Magazine Nat. Hist., V, iii, p. 70, 1879 (*nasicus*).

Gulf of St. Lawrence!, 50 and 70 fathoms, 1873 (J. F. Whiteaves). Greenland (Kröyer). Scandinavian coast! (G. O. Sars, Liljeborg). North Sea, coast of Scotland (Metzger). The Minch, west coast of Scotland (Norman).

**Leucon nasicoïdis** Liljeborg.

*Leucon nasicoïdes* Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 122.—G. O. Sars, Christianiafjordens Dybvandsfauna, p. 41, 1869 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 270 (27).

A single female was dredged at Eastport!, Maine, Bay of Fundy, in 1868. I have also examined one female dredged in the Gulf of St. Lawrence!, by Mr. Whiteaves, in 1873. Scandinavian coast (Liljeborg, G. O. Sars). In life, the specimen from the Bay of Fundy was translucent whitish; the eggs orange.

**Eudorella emarginata** Norman.

*Leucon emarginatus* Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 181, 209, pl. 1, fig. 7, pl. 2, fig. 3, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5, fig. 2, 1849.—Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, p. 6.

"*Cyrtanassa ciliata* Norman, Transactions Tyneside Naturalists' Field Club, v. p. 273, pl. 13, figs. 4-9 ( $\delta$ )" (G. O. Sars); Natural History Transactions of Northumberland and Durham, i, p. 24, 1865.

*Eudora emarginata* G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 185; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Undersøgelser over Christianiafjordens Dybvandsfauna, p. 42, 1869 (extr. Nyt Magazin for Nat.)

*Eudorella emarginata* Norman, in Report of exploring the Hebrides, part ii, Report British Assoc. Adv. Science, 1866, 197, 1867.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 270 (27); Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 44, pl. 18, fig. 98, 1871; Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1877.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 287, 1875.

Off Halifax!, Nova Scotia, 52 fathoms, fine sandy mud, 1877,—two specimens, male and female. Entrance of Gaspé Bay, Gulf of St. Lawrence!, 30 fathoms, 1873 (J. F. Whiteaves). Scandinavian coast! (G. O. Sars, Krøyer, et al.). Scotland! (Norman).

**Eudorella hispida** G. O. Sars.

*Eudorella hispida* G. O. Sars, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 80; Kongl. Vetenskaps-Akad. Handlingar, ix, no. 13, p. 49, pl. 18, figs. 95-97, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i, p. 555 (261), 1874.

Rare in 30 to 35 fathoms, off the coast of New Jersey, north lati-

tude 39° 54', west longitude 73° 15' (Josephine Expedition, G. O. Sars). Salem Harbor!, Massachusetts, 5 fathoms, 1873. Off Cape Ann!, 35 fathoms, sand, and 54 fathoms, sand and mud, 1878. Casco Bay!, 1873: 3 fathoms, mud,—both males and females; males also taken at the surface in the evening. Off Casco Bay, about twenty miles east-southeast from Cape Elizabeth, 50 fathoms, mud, 1873. Bay of Fundy!, 1872, abundant in 1 to 4 fathoms, very soft mud,—both males and females.

### *Eudorella pusilla* G. O. Sars.

*Eudorella pusilla* G. O. Sars, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 79; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 46, pls. 16, 17, figs. 76-94, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i. p. 554 (260), 1874.

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand and mud, 1874, —common, both males and females. Massachusetts Bay!, off Gloucester, 25 fathoms, sand and gravel, 1878. Casco Bay!, 3, 16, 17 fathoms, mud; 9 fathoms, sand and mud, 1873. Bay of Fundy!, 1872, very abundant in 1 to 4 fathoms, very soft mud; also in 10 to 15 fathoms, mud. Gulf of St. Lawrence!, 1873 (Whiteaves).

### *Eudorella deformis* G. O. Sars.

*Leucon deformis* Kröyer, Naturhistorisk Tidsskrift, II, ii, p. 194, pl. 2, fig. 4, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5A, fig. 3, 1849.

*Eudorella* (?) *deformis* G. O. Sars, Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 50, pls. 19, 20, figs. 101 to 118, 1871: Archiv for Mathematisk og Naturvidenskab, Kristiania, ii, p. 345, 1877 (no ?).

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Massachusetts Bay!, off Gloucester, 25 fathoms, sand and gravel, 1878. Greenland (Kröyer). Iceland (G. O. Sars). West coast of Norway (G. O. Sars).

### *Eudorella integra*, sp. nov.

An aberrant form, more like *E. deformis* than any other described species of the genus, perhaps generically distinct from the typical species of *Eudorella*.

*Female*. The cephalothorax is about as long as the abdomen exclusive of the uropods, and regularly and strongly arcuate dorsally.

The carapax, as seen in a side view, is about as long as the first four free segments, nearly three-fourths as high as long, with the dorsal margin approximately parallel with the posterior part of the lateral margins. Both the anterior and posterior portions of the lateral margin are nearly straight, but the anterior portion is directed upward at an angle very oblique to the posterior portion, from which it is separated by a broadly rounded angle. The anterior portion is obscurely denticulate posteriorly but distinctly, though very minutely, toward the slightly prominent anterior angle. The anterior margin is edentate and scarcely at all emarginate; below it is straight and nearly perpendicular, but curved considerably forward above, where the dorsal or inner edges of the lateral lobes are turned abruptly upward at nearly a right angle just in front of the median lobe, to form, as it were, a dorso-frontal rostrum. There is a slight approach to this form of the antero-lateral lobes of the carapax in *E. deformis*, but in that species the dorsal edges of the lobes are prolonged and sharply upturned to form a slender dorsal horn in front of which the edges of the lobes are on a level with, and parallel to, the dorsum back of the horn; while in this new species the whole lateral lobes are prolonged upward and terminate in a slightly incurved edge nearly parallel with the posterior margin of the carapax. The anterior part of the carapax is in fact much as in some of the species of *Leucon*: if the rostrum in *L. nasicoides* were edentate and more strongly upturned, it would represent very nearly the form of this part of the front in the present species.

The major flagellum of the antennula is much shorter than the terminal segment of the peduncle; the minor flagellum falls considerably short of the distal end of the first segment of the major flagellum, but is proportionally larger than in *E. deformis*. The first pereopods are proportionally of about the same length as in *E. deformis*, the carpus reaching to or a little beyond a line with the front, and the segments are relatively of about the same length, but the terminal ones are more slender than in that species. The four posterior pairs of pereopods are distally a little more slender than in *E. deformis*, but do not differ essentially in other respects.

The first five segments of the abdomen increase slightly in length posteriorly and are almost entirely naked, wanting wholly the plumose setae conspicuous beneath the abdomen of *E. deformis*. The sixth segment is about as broad as long, the posterior margin evenly arcuated and armed in the middle with six, or sometimes only four, conspicuous setae. The basal portion of the uropods is stout, scarcely

longer than the sixth segment of the abdomen, and is furnished with a series of long setæ on the inner margin. The inner ramus is much longer than the base; of its two segments the proximal is much the longer and is armed with six to eight stout spines on the inner margin and with three to five much more slender spines on the outer; the distal segment terminates in a very long and stout spiniform tip, at the base of which there is a long seta on the outside, and upon the inner edge about three spines like those upon the proximal segment. The outer ramus is slightly longer than the inner, tapering, and slightly curved outward at the tip, armed along the inner edge and at the tip with a few long setæ, and on the outer edge and above with a few setæ near the middle.

The *adult males* differ from the females as usual in the genus. The carapax is not as high posteriorly, the lateral margin is more nearly straight, not denticulate anteriorly, the anterior angle rounded, and the frontal margin is very nearly straight throughout. The major flagellum of the antennulæ shows distinctly four segments. The uropods are similar to those of the female, but very much more elongated and armed with more numerous and longer spines and setæ, both of which are, as usual, plumose. The setæ which are so conspicuous upon the posterior margin of the terminal segment of the abdomen of the female, appear to be wholly absent in the male.

Length of adult females, about 5<sup>mm</sup>; males a very little longer.

Off Halifax!, Nova Scotia, 1877: females carrying eggs common, 42 fathoms, fine sand, and 52 fathoms, sandy mud; also two females from 57 fathoms, stones, sponges and red algæ. About thirty miles south of Halifax!, 110 fathoms, fine sandy mud. Gulf of St. Lawrence!, 1873 (J. F. Whiteaves): both males and females, south of the eastern part of Prince Edward Island, and in 70 fathoms, off the Bay of Chaleurs.

*Lamprops quadriplicata*, sp. nov.

*Female*. The cephalothorax is as long as the abdomen exclusive of the telson. The carapax is about as long as the first four of the free segments, and, as seen in a side view, very slightly arcuate dorsally, the front truncated above and with a slight sinus in the frontal margin below it, leaving the antero-inferior angle slightly projecting, but obtuse and evenly rounded, and in most of the specimens armed with three or four very minute teeth. On each side of the carapax there are four, very distinct, arcuate and nearly parallel plications, of which the first is short and extends from the antero-inferior angle to

the side of the median lobe of the carapax; the second extends from the inferior margin a little back of the first to the dorsal line at the back of the median lobe; the third and fourth extend from the inferior margin to the dorsal line, the fourth nearly touching the posterior margin above. The minor flagellum of the antennula is only a little longer than the proximal segment of the major flagellum. The carpus in the first pair of pereopods reaches very nearly to a line with the front of the carapax, and the carpus, propodus and dactylus are sub-equal in length. The second pereopods do not quite reach a line with the front, the dactylus and propodus are about equal in length and together about equal to the length of the carpus, which is very slightly longer than the merus. The rudimentary exopods of the third and fourth pereopods have three or four plumose setæ at the tip and several more upon the proximal segment. The basal portion of the uropods is as long as the telson and armed with about ten spines upon the inner margin: the inner ramus is about as long as the basal portion; the first segment is longer than the second and third together and is armed with about sixteen spines on the inner and two or three on the distal part of the outer margin; the second with four or five spines on the inner margin and one at the distal extremity of the outer; the third or terminal with two upon the inner margin and three at the tip: the outer ramus is a little shorter than the inner and its two segments are sub-equal in length. The telson is as long as the fifth segment of the abdomen and about twice as long as the sixth segment, and is armed with either two or three spines upon the distal portion of each lateral margin and at the tip with five spines of about the same size as the marginal ones, though the median is a little larger than the others.

Length 9<sup>mm</sup>.

Smaller, immature females differ in having the anterior pairs of pereopods proportionally shorter than in the adult, and in having fewer spines on the uropods.

The only male seen is about 8½<sup>mm</sup> long and not fully mature, although the antennæ are as long as the cephalothorax and the exopods of the third and fourth pairs of pereopods are fully developed, but there is no indication whatever of rudimentary pleopods. From this fact it seems probable that the adult male is wholly without pleopods, and that this species represents a genus distinct from *Lamprops*.

I have seen only the male just referred to, one female with eggs and a few immature females. Gloucester Harbor!, Massachusetts, 7

to 10 fathoms, sand and red algæ, 1878; Casco Bay!, 1873,—a single immature female taken at the surface in the evening.

*Campylaspis rubicunda* G. O. Sars.

*Cuma rubicunda* Liljeborg. Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 121.

*Campylaspis rubicunda* G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 202: Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Undersøgelser over Christianafjordens Dybrandsfauna, p. 44, 1869 (extr. Nyt Magazin for Nat.); Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 272 (29); Om Cumaceer fra de store dybder i Nordishafvet. Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, xi, no. 6, p. 10, pl. 4, figs. 14-16, 1873.—Norman, in Jeffreys, Valorous Cruise, Proceedings Royal Society, London, xxv, p. 209, 1876; Annals and Magazin Nat. Hist., V, iii, p. 73, 1879.

Off Cape Ann!, Massachusetts, 35 fathoms, sand, 1878. Casco Bay!, stomach of the common flounder (*Pseudopleuronectes Americanus*). Greenland (Norman). Coast of Scandinavia (Liljeborg, G. O. Sars).

*Pelagic species found near the borders of the Gulf Stream off St. George's Banks.*

The following pelagic species, characteristic of the fauna of the Gulf Stream, were taken, in 1872, east of St. George's Banks, north latitude  $41^{\circ} 20'$  to  $30'$ , west longitude  $65^{\circ}$  to  $65^{\circ} 30'$ , and should perhaps be mentioned here, though they in no sense belong to the coast fauna north of Cape Cod. Most, if not all, these semi-tropical pelagic species are, however, occasionally found in summer along the south coast of New England, and the coast of the Middle and Southern States.

*Nautilograpsus minutus* Milne-Edwards.

*Cancer minutus* Linné, Systema Naturæ, edit. 12. i, p. 1040, 1767.—J. C. Fabricius, Systema Entomologiæ, p. 402, 1775; Entomologia systematica, ii, p. 443, 1793; Supplementum Entom. syst., p. 343, 1798.

*Grapsus minutus* Latreille. Hist. nat. Crust. et Insectes, vi, p. 68, 1803.

*Grapsus cinereus* Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 99, 1817 (not *Grapsus cinereus* Bosc, nor *Grapsus (Sesarma) cinereus* Say, loc. cit., p. 442, 1818).

*Grapsus pelagicus* Say, loc. cit., p. 442, 1818.

*Nautilograpsus minutus* Milne-Edwards, Hist. nat. Crust., ii, p. 99, 1837; Annales des Sci. nat., Paris, III, xx, p. 174 (140), 1850.—Goodsir, Annals Magazin Nat. Hist., xv, p. 73, pl. 7, fig. 1, 1845.—Gibbes, Proceedings American Assoc. Adv. Sci.

3d meeting, p. 182 (18), 1850.—Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1858, p. 103 (49); Annals Lyceum Nat. Hist. New York, vii, p. 231 (103), 1860.—Heller, Crustaceen des südlichen Europa, p. 114, 1863.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.

*Planes Linnaeana* Bell, British Stalk-eyed Crust., p. 135 (cut), 1841.—White, List of Crust. British Museum, p. 41, 1847; Catalogue of British Crust. Brit. Museum, p. 19, 1850.

*Planes minutus* Dana, United States Exploring Expedition, Crust., p. 346, 1852.

Gulf of Mexico (Gibbes); Bermuda! (G. Brown Goode); and throughout the warmer parts of the North Atlantic and occasionally upon the English coast (White, Bell, et al.). Mediterranean (Heller). Cape St. Lucas (Stimpson). Indian Ocean (Milne-Edwards).

### Neptunus Sayi Stimpson.

*Portunus pelagicus* Bosc, Hist. nat. des Crust., p. 219, pl. 5, fig. 3, 1805.

*Lupa pelagica* Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 97, 1817.—DeKay, Nat. Hist. New York. Crust., p. 11, pl. 6, fig. 8, 1844.

*Lupa Sayi* Gibbes, Proceedings American Assoc. Adv. Sci., 3d meeting, p. 178 (14), 1850.—Dana, United States Exploring Expedition, Crust., p. 273, pl. 16, fig. 8, 1852.—Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1858, p. 38 (36).

*Neptunus Sayi* Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 220 (92), 1860; Bulletin Museum Comp. Zoology, Cambridge, i, p. 147, 1870.—A. Milne-Edwards, Archives du Muséum d'Hist. Nat., x, p. 317, pl. 29, fig. 2, 1861.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.—Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 319 (4), 1878.

Gulf Stream!, from the Straits of Florida (Stimpson) to north latitude  $41^{\circ} 30'$  (1872) and probably much further, both north and south.

### Latreutes ensiferus Stimpson.

*Hippolyte ensiferus* Milne-Edwards, Hist. nat. des Crust., ii, 374, 1837.—Krauss, Südafrikanischen Crustaceen, p. 56, 1843.—Goodsir, Annals and Magazin Nat. Hist., xv, p. 74, pl. 7, fig. 2, 1845.—Dana, United States Exploring Expedition, Crust., p. 562, 1852.

*Latreutes ensiferus* Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1860, p. 27 (96), 1860.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.—Kingsley, Bulletin Essex Institute, Salem, x, p. 56, 1878.

Bermuda! (G. Brown Goode). Various points in the Gulf Stream!. Near the Azores (Milne-Edwards). African coast (Krauss).

**Leander tenuicornis** Kingsley.

*Palaemon tenuicornis* Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 249, 1818.—DeKay, Nat. Hist. New York, Crust., p. 30, 1844.—White, List of Crust. British Museum, p. 78, 1847.

*Palaemon tenuirostre* Milne-Edwards, Hist. nat. des Crust., ii, p. 395, 1837 (evidently a mistake for *tenuicornis*).

*Palaemon natator* Milne-Edwards, op. cit., ii, p. 393, 1837.

*Palaemon natator* Goodsir, Annals Magazin Nat. Hist., xv, p. 74, pl. 7, fig. 3, 1845.—White, List of Crust. British Museum, p. 77, 1847.—Dana, United States Exploring Expedition, Crust., p. 588, pl. 38, fig. 11, 1852.—Heller, Crustaceen des südlichen Europa, p. 268, pl. 9, figs. 11, 12, 1863.

*Leander erraticus* Desmarest, Annales Soc. Entomologique de France, II, vii, p. 92, cut, 1849.

*Leander natator* Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1860, p. 40 (109).

*Leander tenuicornis* Smith, MSS.—Kingsley, Bulletin Essex Institute, Salem, x, p. 66, 1878.

Off Gaudeloupe (Desmarest). Various parts of the Gulf Stream! Bermuda!, (G. Brown Goode). North latitude  $41^{\circ} 25'$ , west longitude  $66^{\circ} 20'$ ! (1872). Banks of Newfoundland (Say).

**Siriella?** sp.

A single immature female, apparently belonging to this genus, was taken east of St. George's Banks, latitude  $41^{\circ} 25'$ , longitude  $65^{\circ} 10'$ , by Mr. Harger and myself, September 15, 1872.

**Lucifer** sp.

Taken at the same time and place as the last species.

*On the Geographical Distribution of the foregoing species, and on the Relation of the Fauna of the Atlantic coast of North America north of Cape Cod to that of Greenland and Europe.*

In order to exhibit in a connected manner the principal facts in regard to the geographical and bathymetrical distribution of the species properly belonging to the marine fauna of our coast north of Cape Cod, I have prepared the following tabular synopsis.

The headings of a part of the eleven columns, in which the geographical distribution is indicated, do not state fully the region included, so that the following explanations are necessary. Under "South of Cape Cod," all those species are included which are found

anywhere near the south coast of New England or the coast still further south, whether they properly belong to the fauna south of the Cape or are northern species which occur only in exposed situations, in deep water, or in winter; but to distinguish these two classes of species, the northern ones are indicated by an asterisk (\*). Under "Massachusetts Bay," two or three rare species taken off Cape Ann, but not as yet actually in the Bay, are included. Under "Nova Scotia," only those species which have been observed on or near the southeast coast are included; the species of the northern, or Gulf-of-St. Lawrence, coast being included in the eighth column, while a few species taken only in deep water (one hundred or more fathoms) far off the Atlantic coast, are included in the seventh column. Under "Gulf of Maine, etc.," are included the species found in the Gulf of Maine proper (the great region of comparatively deep water, but with numerous banks and "ledges," between St. George's Banks and the shallow waters of the coast from Cape Cod to Nova Scotia), and also the species found on St. George's Banks, LeHave Bank, etc., and the deep waters outside of them. Under "Gulf of St. Lawrence and Labrador," are included the species found in the Gulf and on the east, or Atlantic, coast of Labrador, though in the present list all the species known from the east coast of Labrador have been found also in the Gulf. A few species which have been found in the shallow southwestern part, including Northumberland Straits and the Bay of Chaleurs, and not in other parts of the Gulf, are indicated by a dagger (†). Under "Bering Sea," species known from any part of the North Pacific or from the Arctic Ocean immediately north of Bering Straits are included. The number of species common to this region and the North Atlantic will undoubtedly be very largely increased by subsequent investigation.

In checking in the table the occurrence of the species, a mark of affirmation (!) is used, as in the previous pages, when I am myself responsible for the identification of the species; the plus sign (+), when the species has not been seen by me but has been recorded on good authority; and by a mark of interrogation (?), when there is doubt in regard to the identification of the species.

In the bathymetrical distribution, under "Fathoms," the depths within which the species have been found upon our coast only are given.

	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scotia.	G. of Maine, etc.	G. St. Lav. and Lab.	Greenland.	Europe.	Bering Sea.	Fathoms.
<i>Gelasimus pugnax</i> .....	!	!										Shore.
<i>pugilator</i> .....	!	!										"
<i>Callinectes hastatus</i> .....	!		+									0- 2
<i>Platyonichus ocellatus</i> .....	!	!										0- 10
<i>Carcinus mænas</i> .....	!	!								!		0- 2
<i>Geryon quinquedens</i> .....							!					100-160
<i>Panopeus depressus</i> .....	!	!										0- 5
<i>Sayi</i> .....	!	!										0- 5
<i>Harrisii</i> .....	!		!									0-
<i>Cancer irroratus</i> .....	!	!	!	!	!	!	!	!				0- 50
<i>borealis</i> .....	!		!	!	+	+						0- 10
<i>Chionœetes opilio</i> .....							!	!	+		!	88-101
<i>Hyas araneus</i> .....			!	!	!	!	!	!	!	!	+	16- 60
<i>coarctatus</i> .....	!*		!	!	!	!	!	!	+	!		0-150
<i>Libinia emarginata</i> .....	!	!	!	!	!							0- 5
<i>Lithodes maia</i> .....			!	!	!		!	+	?	!		50-250
<i>Eupagurus bernhardus</i> .....	!*		!	!	!	!	!			!	+	0-150
<i>longicarpus</i> .....	!	!	+	!								0- 10
<i>pubescens</i> .....	!*		!	!	!	!	!	!	+	+	+	0-150
<i>Krøyeri</i> .....			!	!	!	!	!	!	+	!	+	8-430
<i>Parapagurus pilosimanus</i> .....							!					250
<i>Munidopsis curvirostra</i> .....							!					180-220
<i>Homarus Americanus</i> .....	!	!	!	!	!	!	!					0- 10
<i>Axius serratus</i> .....			+				!					20- 40
<i>Calocaris Macandree</i> .....								+		+		190-
<i>Crangon vulgaris</i> .....	!	!	!	!	!	!	!	!		!		0- 48
<i>boreas</i> .....			!	!	!	!	!	!	+	!	+	0- 33
<i>Sabinea septemcarinata</i> .....			!	!	!	!	!	!	+	!	?	26- 68
<i>Sarsii</i> .....							!			!		60-112
<i>Pontophilus Norvegicus</i> .....						!	!			!		101-115
<i>Nectocrangon lar</i> .....					!		!	+		+		29- 59
<i>Caridion Gordoni</i> .....				!	!	!	!			!		27-110
<i>Hippolyte Fabricii</i> .....			!	!	!	!	!	!	+		+	0- 64
<i>Gaimardii</i> .....			+	!	!	!	!	!	+	!	+	0- 57
<i>spinus</i> .....			!	!	!	!	!	!	+	!	+	0- 90
<i>securifrons</i> .....			!			!	!			!		27-190
<i>macilenta</i> .....					!		!	+				26- 70
<i>Phippsii</i> .....			!	!	!	!	!	!	+	!	+	10-125
<i>pusiola</i> .....	!*		!	!	!	!	!	!		!		0-105
<i>polaris</i> .....			!	!	!	!	!	!	+	!	+	10-100
<i>Grœnlandica</i> .....			!	!	!	!	!	!	+		+	6- 33

	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scotia.	G. of Maine, etc.	G. St. Law. and Lab.	Greenland.	Europe.	Bering Sea.	Fathoms.
<i>Pandalus borealis</i> .....			!			!	!		+	!	+	40-160
<i>Montagui</i> .....	!*		!	!	!	!	!		+	!		10-430
<i>Palaemonetes vulgaris</i> .....	!		!									
<i>Pasiphaë tarda</i> .....							!		+	!		140-175
<i>Thysanopoda Norvegica</i> .....			!	!	!	!	!		+	!		0-430
<i>inermis</i> .....	!*		!	!		!	!		+	!		0-220
<i>Erythrops Goëssii</i> .....			!							!		20- 48
<i>Meterythrops robusta</i> .....			!				!					33- 70
<i>Pseudomma roseum</i> .....							!	!		!		105-210
<i>truncatum</i> .....							!					45- 70
<i>Heteromysis formosa</i> .....	!		!									0- 10
<i>Mysis mixta</i> .....			!	!	!		!		+?	!		20- 90
<i>stenolepis</i> .....	!		!	!	!							0- 18
<i>oculata</i> .....					?		!		+	+		0-
<i>Americana</i> .....	!		!	!								0- 5
<i>Diastylis Rathkii</i> .....					!	!	!		+	!		20- 57
<i>politus</i> .....	!		!	!	!	!	!	!				0-190
<i>sculptus</i> .....	!		!	!	!	!	!	!				0-190
<i>luciferus</i> .....					!		!			!		60- 97
<i>quadrspinus</i> .....	!*		!	!	!	!	!	!				2-190
<i>abbreviatus</i> .....	+		!	!								17- 35
<i>Leptostylis longimanus</i> .....				!							+	
<i>ampullaceus</i> .....							!			+		52- 90
<i>Leucon nasiceus</i> .....							!		+	!		50- 70
<i>nasicoides</i> .....					!		!			+		
<i>Eudorella emarginata</i> .....					!		!			!		52
<i>hispida</i> .....	+		!	!	!		!					1- 54
<i>pusilla</i> .....	!		!	!	!		!			!		1- 25
<i>deformis</i> .....	+*		!						+	+		25
<i>integra</i> .....					!	!	!					42-110
<i>Lamprops quadripleata</i> .....			!	!								0- 10
<i>Campylaspis rubicunda</i> .....			!	!					+	+		35



appear to be represented in the European Seas. Of the five other species recorded from Cape Cod Bay, all are common far to the south and none of them are truly arctic species, although a single one, *Crangon vulgaris*, extends north to the Gulf of St. Lawrence and to Europe.

The following, in addition to list (1), are southern species occurring north of Cape Cod Bay only accidentally or in exceptionally protected localities:

Callinectes hastatus.	Palaemonetes vulgaris.	(2.)
Panopeus Harrisii.	Heteromysis formosa.	
Libinia emarginata.	Mysis Americana.	
Eupagurus longicarpus.		

Excluding the species in lists (1, 2), there are left eighteen northern species which extend south of Cape Cod. Of these,

Hyas coarctatus,	Pandalus Montagu,	(3.)
Eupagurus bernhardus,	Thysanopoda inermis,	
E. pubescens,	Eudorella deformis,	
Hippolyte pusiola,		

are northern and European species which extend but a short distance south of Cape Cod, where they are found usually only in cool waters of exposed localities, or, in the case of *Thysanopoda inermis*, only in winter.

Of the eleven remaining species which occur both north and south of Cape Cod,

Cancer irroratus.	Crangon vulgaris.	(4.)
C. borealis,	Mysis stenolepis,	
Homarus Americanus,		

have about equally extensive ranges and are about equally common both north and south of Cape Cod, and must be regarded as belonging properly to both faunæ. The others,

Diastylis politus,	Diastylis abbreviatus.	(5.)
D. sculptus.	Eudorella hispida,	
D. quadrispinosus,	E. pusilla,	

are all Cumacea which may fall in the same category as the four preceding species, although it is probable that some or perhaps all of them will be found to belong more exclusively to the northern fauna. None of the species in the last two lists are known to extend far north, nor, with the exception of *Crangon vulgaris*, to Europe, although they all belong to genera well represented in European seas.

Excluding, from the number of species recorded from both north and south of Cape Cod Bay, the seven southern species (2) which

occur locally or accidentally north, and the seven southern species (3) which occur similarly south of Cape Cod, there are left only eleven species (4, 5) which can be properly regarded as common to two regions of the New England coast. This fairly represents, I think, the marked difference between the two faunæ; a difference due principally to the difference in the temperature of the water, but partially undoubtedly, to the different structure of the coast and to the different nature of the shore and bottom in the two regions.

That there is no similar change in the fauna of the coast and shallow waters from Massachusetts Bay to Labrador is well shown by a comparison of the fauna of Massachusetts and Casco Bays with the fauna of the Gulf of St. Lawrence at similar depths. Omitting the southern species of lists (1, 2) and also the deep-water species (8) which are ordinarily not found at depths less than fifty fathoms, the following species are left recorded from Massachusetts and Casco Bays; those not yet recorded from the Gulf of St. Lawrence being prefixed by an asterisk:

Cancer irroratus.	Hippolyte Grœnlandica.	(6.)
*C. borealis.	*Pandalus borealis.	
Hyas araneus.	P. annulicornis.	
H. coarctatus.	Thysanopoda Norvegica.	
*Eupagurus bernhardus.	T. inermis.	
E. pubescens.	*Erythrogs Goëssii.	
E. Krøyeri.	Meterythrogs robusta.	
Homarus Americanus.	*Mysis mixta.	
*Axius serratus.	*M. stenolepis.	
Crangon vulgaris.	Diastylis politus.	
C. boreas.	D. sculptus.	
Sabinea septemcarinata.	D. quadrispinosus.	
*Caridion Gordoni.	*D. abbreviatus.	
Hippolyte Fabricii.	*Leptostylis longimanus.	
H. Gaimardii.	*Eudorella hispida.	
H. spinus.	E. pusilla.	
*H. securifrons.	*E. deformis.	
H. Phippsii.	*Lamprogs quadriplicata.	
H. pusiola.	*Campylaspis rubicunda.	
H. polaris.		

This list contains all the species recorded from less than fifty fathoms in the Bay of Fundy (unless *Mysis oculata* or *Leucon nasicoïdes* may prove to be exceptions), and is, as far as known, a complete list of the species which should be regarded as the regular inhabitants of the coast region of northern New England. Only six species additional to this list are recorded from the Gulf of St. Lawrence; they are the following:

Nectocrangon lar.		Mysis oculata.	(7.)
Hippolyte macilentæ.		Diastylis Rathki.	
Pseudomma truncatum.		Leucon nasicooides.	

With the exception of the new species of *Pseudomma*, these are all thoroughly arctic species, and show a slight increase in the arctic character of the fauna of the Gulf of St. Lawrence over that of northern New England. The *Nectocrangon*, the *Hippolyte*, and the *Diastylis* were found also upon the Atlantic coast of Nova Scotia and may, very likely, yet be found on the New England coast; while the *Leucon* is already known from the Bay of Fundy and will doubtless yet be found in Casco and Massachusetts Bays.

The fifteen species from Massachusetts and Casco Bays (6) not yet recorded from the Gulf of St. Lawrence afford very little evidence in regard to the relations of the fauna of the Gulf, for some of them are known to be arctic and will undoubtedly be found in the Gulf, and the distribution of most of the others is not sufficiently well ascertained to be used as evidence. The absence of *Eupagurus bernhardus* from the Gulf of St. Lawrence and Greenland, while it occurs on the New England coast, in Europe, and in the North Pacific is, however, an interesting fact which should not be overlooked.

The shallow southwestern part of the Gulf of St. Lawrence, including the region of Northumberland Straits, etc., as shown particularly by its Molluscan fauna, is much more southern in its character than the rest of the Gulf; but too little is known of the stalk-eyed crustaceans of this region to illustrate the fact, or to affect the statements above made in regard to the fauna of the Gulf as a whole, for the species which are recorded from this part of the Gulf only are all Cumacea of which the distribution is not sufficiently known to make their occurrence here evidence in regard to the character of the fauna.

The deep-water species, or those which have not been recorded from less than fifty fathoms on our coast, and which are not inserted in lists (6, 7), are the following; those known from the Gulf of Maine, from off the coast of Nova Scotia, etc., being indicated by an M; those from the Gulf of St. Lawrence, by an L:

M Geryon quinquegens.		M Pasiphaë tarda.	(8.)
M L Chionæcetes opilio.		M Pontophilus Norvegicus.	
M L Lithodes maia.		M L Pseudomma roseum.	
M Parapagurus pilosimanus.		M L Diastylis luciferus.	
L Munidopsis curvirostra.		M Leptostylis ampulaceus.	
L Calocaris Macandrewæ.		M L Leucon nasium.	
M Sabineæ Sarsii.		M L Eudorella emarginata.	

The differences between the deep-water faunæ of the two regions, as shown in this list, are probably wholly accidental, the species which are not known to be common to both regions, being new or, at least on the western side of the Atlantic, little known species which will, most likely, eventually be found to inhabit both regions.

The facts above presented show conclusively, I think, that, as far as the Thoracostraca are concerned, the fauna from Cape Cod Bay to Labrador is essentially a continuous one, or at least that there are no changes in it comparable with the differences between the fauna south and that north of Cape Cod Bay. An uncompleted investigation of the distribution of the Amphipoda sustains these conclusions, which appear to be essentially in harmony with the facts at present known in regard to the distribution of the Mollusca and of other groups of the better known marine animals of the region in question.

Of the fauna of the east, or Atlantic, and of the north coast of Labrador, very little is at present known, but I believe no species of crustaceans, which are not found also in the Gulf of St. Lawrence or further to the south, have been recorded from this region, and the very close resemblance between the fauna of the northern part of the Gulf and that of the Greenland seas (to which I shall presently allude) renders it very improbable that the fauna of the east and north coasts of Labrador differs essentially from that of the northern part of the Gulf of St. Lawrence. The close relationship existing between the marine fauna of Greenland and that of northern Europe has long been observed and fully admitted by European zoologists, but the similarly close relationship between the marine fauna of Greenland and that of the coasts of the continent of North America itself, as well as the similar relationship between the fauna of the latter region and that of the seas of northern Europe, has not been so generally recognized by them and has recently been strenuously controverted.\* This has probably been largely due to the fact that

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\* Dr. J. Gwyn Jeffreys: Preliminary Report of the Biological Results of a cruise in H. M. S. Valorous to Davis Strait in 1875. Proceedings Royal Society, London, vol. xxv, p. 188, 1876.

The Rev. A. M. Norman, however, appears to have fully recognized the true relation between the faunæ of the eastern and western sides of the North Atlantic, and also the American rather than the European character of the fauna of the Greenland seas; and in this very report arrives at conclusions the reverse of those of Mr. Jeffreys. Mr. Norman has, in a letter received since these pages were written, very kindly communicated to me his general conclusions in regard to the fauna of the North Atlantic, and I am pleased to find that his investigations in nearly all the classes of marine Invertebrata, have led to conclusions essentially the same as those resulting from my special study of the Thoracostraca.

the Greenland fauna has been studied almost exclusively by European zoologists to whom the fauna of our coast has usually been very little known. The earlier American zoologists fell into the same error, and, being without specimens of the known European species for comparison, and without sufficiently accurate figures or descriptions, described as new species already known from European and Greenlandic seas. This process has sometimes been reversed, however, the species being first described from our coast and later from the European. But the crustaceans have been more fortunate in this respect than some other classes of animals.

Further on, I have discussed the facts in regard to the geographical distribution of the Thoracostraca of Greenland, and need not specially allude to them here. The relation of the Thoracostracan fauna of the region between Cape Cod and Labrador to that of Greenland, that of Europe, and that of the region of Bering Sea, is shown in a general way in the summary, previously given, of the table of distribution (A), but is better shown if we omit from the summary the southern species (1, 2) which properly have no place in the fauna. Rejecting these, there are left belonging to the fauna between Cape Cod Bay and Labrador, sixty species, of which twenty-six are known in Greenland, thirty-seven in Europe, and fourteen in the region of Bering Sea. This is shown for different groups of Thoracostraca, in the following table:

(B.)	Cape Cod to Labrador.	Greenland.	Europe.	Region of Bering Sea.
Brachyura .....	6	3	2	2
Anomura .....	6	2	4	3
Macrura .....	22	13	16	9
Total Decapoda .....	34	18	22	14
Schizopoda .....	9	4	6	
Cumacea .....	17	4	9	
Total .....	60	26	37	14

This shows that a little more than three-fifths (sixty-one per cent.) of the species known to our northern marine fauna are common to the European fauna, while over two-fifths (forty-three per cent.) are found in Greenland, and that the proportions are very nearly the same if

the comparison be restricted either to the Decapoda proper, the Schizopoda, or the Cumacea.

The numerical distribution of the above twenty-six species known to be Greenlandic, along the western side of the North Atlantic is shown in the last five columns of table (D) beyond.

The similar distribution of the thirty-seven species common to our fauna and that of the European seas, and also the whole number of species recorded from each of the regions included in the second, third, fourth and fifth columns, is given in the following table, in which the fifth column is made to include the number of species found at less than fifty fathoms along the New England coast north of Cape Cod, while the other columns include the same regions as in table (A):

(C)	Europe.	Greenland.	G. St. Lawrence.	G. of Maine, etc.	N. Eng. coast north Cape Cod.	South of Cape Cod.	Region of Bering Sea.
Brachyura .....	2	2	2	2	2	1	1
Anomura .....	4	2	3	4	4	1	3
Macrura .....	16	9	10	14	12	3	6
Total Decapoda .....	22	13	15	20	18	5	10
Schizopoda .....	6	4	4	4	4	1	
Cumacea .....	9	4	5	1	6	1	
Total European .....	37	21	24	25	28	7	10
Whole no. recorded .....		36	39	37	42		

Comparing the number of European species found in each of the four regions north of Cape Cod, with the whole number of species recorded from each of these regions, as given in the last line of the table, it will be seen that the proportion of European species is very nearly the same in each of the regions, while south of Cape Cod there is a very sudden diminution in the number of European species.

Thirty of the thirty-seven species common to the two sides of the North Atlantic are known to occur on our coast in fifty fathoms or less, while some of the remaining species are recorded from equally shallow water in the European seas. This is a smaller proportion of deep-water species than is found among the species which are left as peculiar to the fauna between Cape Cod and Labrador, which shows that the species common to Europe and America are not predominantly deep-water species.

In the following list of the twenty-three species belonging to the fauna between Cape Cod and Labrador and not known to be European, those which are known to be true arctic species are indicated by an A; those which extend south of Cape Cod and appear to have their center of distribution on the New England coast are indicated by an S, but some of the Cumacea thus indicated may very likely prove to be arctic species.

Geryon quinquedens.	A Hippolyte Grœnlandica.	(9.)
S Cancer irroratus.	Meterythrops robusta.	
S C. borealis.	Pseudomma truncatum.	
A Chionoecetes opilio.	S Mysis stenolepis.	
Parapagurus pilosimanus.	S Diastylis politus.	
Munidopsis curvirostra.	S D. sculptus.	
S Homarus Americanus.	S D. quadrispinosus.	
Axius serratus.	S D. abbreviatus.	
A Nectocrangon lar.	S Eudorella hispida.	
A Hippolyte Fabricii.	S E. pusilla.	
A H. macilenta.	E. integra.	
	S Lamprops quadriplicata.	

Excepting *Axius serratus* (which will very likely prove to be specifically identical with the European species), the species not prefixed by either A or S, are all new or recently described and little is yet known of their geographical range, but they are probably arctic species. It is worthy of notice that, of the five species known to be arctic and not known to be European, all are Greenlandic and all but one (*Hippolyte macilenta*) are also known to occur on the western coast of North America, in the region of Bering Sea. These four species, common to both the northern Atlantic and northern Pacific coasts of North America are all conspicuous forms not likely to escape detection, and their geographical distribution apparently indicates that there are a certain number of arctic American species which are not European—perhaps because they are too arctic to be European.

*The relation of the Thoracostracan Fauna of Greenland to that of the rest of North America and to that of Europe.*

In order to exhibit clearly the similarity of the relation of the Thoracostracan fauna of Greenland, on the one hand, to the fauna of the rest of the North American seas, and, on the other hand, to that of the European seas, I have compiled the following list of the species of Thoracostraca known to inhabit the Greenland coast, and have given in foot-notes the principal synonyms, the most important refer-

ences, and the geographical distribution, for the species not known from the region between Cape Cod and Labrador, and consequently not treated of in the foregoing pages, where the geographical distribution of all the other species is given. The species known from the eastern coast of North America are indicated by the letters E. A. (all these occur in the Gulf of St. Lawrence or further south); those from the western coast (the region of Bering Sea, etc.) by the addition of the letter W.; those from the European coast by the letter E.

Chionæcetes opilio,	E. & W. A.		H. macilenta,	E. A.	
Hyas araneus,	E. & W. A.	E.	H. Phippsii,	E. & W. A.	E.
H. coarctatus,	E. A.	E.	H. polaris.	E. & W. A.	E.
Eupagurus pubescens,	E. & W. A.	E.	H. Grœnlandica,	E. & W. A.	
E. Krøyeri,	E. & W. A.	E.	H. microceras.†		
Crangon boreas,	E. & W. A.	E.	H. Panschii.‡		
Sabinea septemcarinata.	E. & W. (?) A.	E.	Pandalus borealis,	E. & W. A.	E.
Nectocrangon lar,	E. & W. A.		P. Montaguï,	E. A.	E.
Hippolyte Fabricii,	E. & W. A.		Hymenodora glacialis,§		E.
H. Gaimardii, *	E. & W. A.	E.	Pasiphaë tarda,	E. A.	E.
H. incerta,*			Sergestes arcticus,		
H. spinus,	E. & W. A.	E.			

\* HIPPOLYTE INCERTA Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 272, 1874. East Greenland (Buchholz). Perhaps only a variety of *H. Gaimardii*.

† HIPPOLYTE MICRO CERAS Krøyer, Naturhistorisk Tidsskrift, iii, p. 578, 1841; Monografisk Fremstilling af Slægten Hippolyte's nordiske Arter, Kgl. danske Vidensk. Selsk. Skr., naturvidensk. mathem. Afh., ix, p. 341 (*microceros*), pl. 5, fig. 105-109 (*microceras*), 1842.—Lütken, list of Crust. of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148. Greenland (Krøyer).

‡ HIPPOLYTE PANSCHII Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 277, pl. 1, fig. 1, 1874.—Kingsley, Bulletin Essex Institute, Salem, x, p. 62, 1878. East Greenland (Buchholz).

§ HYMENODORA GLACIALIS G. O. Sars.

*Pasiphaë glacialis* Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 279, pl. 1, fig. 2, 1874.—Kingsley, Bulletin Essex Institute, Salem, x, p. 69, 1878 (*Pasiphaë*).

*Hymenodora glacialis* G. O. Sars, Archiv for Mathematikk og Naturvidenskab, Kristiania, ii, p. 341, 1877.

East Greenland (Buchholz). Deep water off the coast of Norway (G. O. Sars).

|| SERGESTES ARCTICUS Krøyer, Oversigt Kgl. danske Vidensk. Selsk. Forhandling, Kjøbenhavn, 1855, p. (6); Forsøg monog. Fremstil. Kræbsdyrslægten Sergestes, Kgl. danske Vidensk. Selsk. Skr., V, naturvidensk. mathem. Afh., iv, pp. 240, 276, pl. 3, fig. 7, pl. 5, fig. 16, 1859.

Greenland (Krøyer).

Thysanopoda Norvegica.	E. A.	E.	Diastylis Rathkii.	E. A.	E.
T. inermis.	E. A.	E.	D. Edwardsii, §		
T. longicaudata.*			D. resimus, ¶		
T. Raschii, †		E.	Leucon nasieus,	E. A.	E.
? Mysis mixta.	E. A.	E.	Eudorella deformis,	E. A.	E.
M. oculata.	E. A.	E.	Campylaspis rubicunda,	E. A.	E.
Boreomysis arctica, ‡		E.			

The following table gives a numerical summary of this list, and also the numerical distribution of the species in several regions along the eastern coast of the continent of North America.

\* **THYSANOPODA LONGICAUDATA** Krøyer, in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 8, fig. 1, 1849.—Lütken, list of Crust. of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148.  
Greenland (Reinhardt, Lütken).

† **THYSANOPODA RASCHII** Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1863, p. 83.—Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 285, 1874.  
Coast of Norway (Sars). East Greenland (Buchholz).

‡ **BOREOMYSIS ARCTICA** G. O. Sars.

*Mysis arctica* Krøyer, Et Bidrag til Kundskab om Kiebsdyrfamilien Mysidae, Naturhistorisk Tidsskrift, III, i, pp. 34, 42, pl. 1, fig. 5, 1861.

*Boreomysis arctica* G. O. Sars, Christianiafjordens Dybvandsfauna, p. 26, 1869 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 264 (21).—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.  
Greenland (Krøyer). West coast of Norway (G. O. Sars, Metzger).

§ **DIASTYLIS EDWARDSII** Krøyer.

*Cuma Edwardsii* Krøyer, Naturhistorisk Tidsskrift, iii, pp. 504, 531, pl. 5, figs. 1-16, 1841; op. cit., II, ii, pp. 128, 207, pl. 1, figs. 1, 3, 5, 9-14, 1846; in Gaimard, Voyages en Scandinavie, etc., pl. 4, 1849 (♀).

*Cuma brevisrostris* Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 174, 208, 1846; Voyages en Scandinavie, etc., pl. 5A., fig. 1, 1849 (adult ♂).

*Diastylis Edwardsii* G. O. Sars, Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.—Norman, Proceedings Royal Soc., London, xxv, p. 209, 1876; Annals and Magazin Nat. Hist. V, iii, p. 61, 1879.

Greenland (Krøyer, Norman).

¶ **DIASTYLIS RESIMUS** G. O. Sars.

*Cuma resima* Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 165, 206, 1846; Voyages en Scandinavie, etc., pl. 3, fig. 1, 1849.

*Diastylis resima* G. O. Sars, Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.

Greenland (Krøyer).

(D.)	Greenland.	Europe.	Eastern coast of North America.	G. St. Lawrence.	G. Maine, etc.	N. Eng. coast north Cape Cod.	South of Cape Cod.	Region of Bering Sea.
Brachyura .....	3	2	3	3	3	2	1	1
Anomura .....	2	2	2	2	2	2	1	3
Macrura .....	18	10	13	11	11	9	1	6
Total Decapoda .....	23	14	18	16	16	13	3	10
Schizopoda .....	7	6	4	3	3	2	1	
Cumacea .....	6	4	4	2	1	2		
Total .....	36	24	26	21	20	17	4	10

Of the thirty-six Greenland species, six are not yet recorded from outside the Greenland seas, so that out of thirty species, twenty-six, or about eighty-seven per cent., are known upon the eastern coast of North America from the Gulf of St. Lawrence southward; while twenty-four species, or eighty per cent., are known in the European seas. An uncompleted examination of the Amphipoda gives results entirely in harmony with those above derived from the Thoracostraca, so that it is certainly safe to assert that, at least as far as the Malacostraca are concerned, the marine fauna of Greenland is essentially the same as that of the arctic seas of both Europe and America, or, in other words, it is only a part of the great arctic, circumpolar fauna. That the fauna of the Greenland seas should have its closest relations with the fauna of the North American coast proper, rather than with that of Europe, is what might be expected from the geographical position of Greenland and the fact that the waters of the northern part of the North American coast are more arctic in temperature than the waters upon the coast of Europe.

#### ERRATA.

Page 31, 2d line. for 'Robert,' read 'Richard.'

" 54, for 'Munadopsis,' read 'Munidopsis.'

" 61, 6th line from bottom, for 'Mere,' read 'Meere.'

" 69, 9th line from bottom, for 'Tynside,' read 'Tyneside.'

" 105, 3d line from bottom, insert 'of' before '*M. oculata*.'

" 115, 1st line, for 'nasicoidis,' read 'nasicoides.'

" 129, 16th line. for '*Pseudopleuronectes*,' read '*Pseudopleuronectes*.'